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A

MEMOIR

ON THE

PALAEOZOIC RETICULATE SPONGES

CONSTITUTING THE FAMILY

DICTYOSPONGIDÆ.

BY

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IN COLLABORATION WITH

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PART I

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PREFACE.

This Monograph of the DICTYOSPONGIDÆ is the conclusion of an undertaking, the inception of which is indicated by my publication upon these fossils in 1884. Up to the year 1863, only occasional expressions had been made with reference to the nature of such bodies; first, by Mr. T. A. CONRAD, after the close of his connection with the Geological Survey of the State and, again, in the same year (1842), by Mr. LARDNER VANUXEM, in his final report on this Survey. The specimens which came under the notice of these observers were as widely unlike as the limits of the family permit, and while CONRAD considered his specimen, HYDNOCERAS, a cephalopod, VANUXEM regarded the form described by him, UPHANTÆNIA, as a marine plant. In my paper of 1863, I was disposed to accept VANUXEM's views of these bodies as nearer the truth.

In the years which intervened, from 1863 to the date of publication of my second paper, in 1884, specimens had begun to accumulate in the collections of the State Museum, and toward the latter part of this period especial efforts were made to gather material that would justify a more thorough study of the subject, though little anticipating that it would ever assume the comprehensive proportions with which it appears to-day. While new material was gradually being acquired from the Chemung rocks of this State, as one result of the activity of collectors sent out on behalf of the Palaeontology of New York, additional forms were obtained from the Waverly sandstone of Ohio, during the survey of that state by the late Dr. J. S. NEWBERRY; and admirable specimens were being found in the calcareous shales of the Keokuk group at Crawfordsville, Indiana. It was the acquisition and study of this last named material, that led to the determination by Mr. R. P. WHITFIELD, in 1881, of the spongous nature of these fossils.

In order to show the progress which had been made in the study of these organisms, I issued in 1882, four large octavo plates of figures with explanations and, in 1884, reproduced these plates with a brief descriptive account of the fossils illustrated. In 1890, an addition to the known species was made by the publication (though without illustrations) of a group of Chemung

species, a paper prepared at my request by Mr. JOHN M. CLARKE. With this publication, forty-two species of these sponges had been described from the palaeozoic rocks of the United States.

So rapid has been the growth of these collections and so generous the disposition of all collectors and students toward the perfecting of this monograph, that to-day we present descriptions of about thrice the number of specific forms recognized as such, seven years ago. This wonderful increase is not especially a matter for congratulation, save that it serves to show the amazing diversity of these siliceous sponges in late Devonian and early Carboniferous faunas. The species and genera are established in accordance with the best standards attainable for these variable organisms. Future collections and observations may show that these divisions are not in all cases sharply defined; they will undoubtedly show that the present account of this organic element in these ancient rocks is far from being complete.

In 1892, Mr. CLARKE undertook a revision of all previous work upon these fossils and this, with the elaboration of new material, he has carried forward to its present state.

During the preparation of the work, many favors have been shown by geologists and others having specimens of DICTYOSPONGIDÆ in their collections. Acknowledgments are due to them all, but our obligation to some requires particular mention.

This monograph could never have been made what it now is, were it not for the enthusiastic cooperation of Mr. EDWIN B. HALL, of Wellsville, N. Y. Mr. HALL has demonstrated a wonderful abundance of the DICTYOSPONGIDÆ in the upper Chemung rocks of New York. His collections, which are constantly growing under his zealous explorations, are remarkably rich in this material and have been at all times accessible for use in this work. It is to be remarked, with some regret in view of the issuance of this book, that Mr. HALL'S more recent collections afford evidence that as yet we are far from having a full representation of the hexactinellid sponge fauna of this geologic period, notwithstanding that more than sixty species of this ancient date are here illustrated. With our present knowledge, the middle and upper beds of the Chemung group in Allegany and Cattaraugus counties appear to have been the seat of extensive sponge plantations, more prolific in diverse forms and individuals than the region immediately to the east and west. This impression may, however, be a mistaken one and due to the fact that Chautauqua, Chemung and

Broome counties have yet to be as carefully explored for these fossils as have been Allegany, Cattaraugus and Steuben counties.

To the late Reverend JONATHAN ALLEN, former president of Alfred University at Alfred, Allegany county, an early and interested collector of these sponges, I owe many favors. From him, by loan and purchase, I obtained some interesting specimens, and at one time employed his son to make collections from the localities in and about Alfred.

Mr. D. DANA LUTHER, both before and during his engagement upon the geologic work of this department, has supplied a number of interesting forms from the lower beds of the Chemung group in Ontario, Yates and Steuben counties, and has recently discovered DICTYOSPONGIDÆ in some variety in the shales and sandstones of the Portage group, in Wyoming and Ontario counties; a formation from which they had not been previously obtained.

As early as 1883, Professor CHARLES BARROIS, of the University of Lille, demonstrated the existence of DICTYOSPONGIDÆ in the Psammites du Condroz of Brittany. The forms which were described by him are noteworthy in their similarity to those occurring in our equivalent geologic horizon, the Chemung group. Professor BARROIS, with most courteous liberality, has placed these specimens, together with some later collections from the same horizon, in my hands for comparative study, with full permission to illustrate and describe them. As no other part of the world has yet furnished species so closely allied to the American Dictyosponges, we have gladly availed ourselves of this privilege and these French species will be found fully described and illustrated in this volume.

Further,—to the following gentlemen and institutions, acknowledgment is here made for their courtesy in the loan of specimens.

Sir WILLIAM DAWSON, of Montreal, whose important descriptions of various beautiful forms of PROTOSPONGIDÆ from the slates at Little Metis are well known, and who has kindly loaned a nearly complete series of his species for comparative study.

Mr. A. S. TIFFANY, of Davenport, Iowa, for the loan of specimens from Crawfordsville, Indiana, representing the new genus LEBEDICTYA, and specimens of CLATHROSPONGIA both from the locality mentioned and from the Waverly group of Ohio.

Mr. J. F. CARLL, of Pleasantville, Pennsylvania, who has supplied specimens from the lower Carboniferous rocks of Pennsylvania, upon which we have established the species *Calathospongia Carlli*.

Through the kindness of Prof. I. C. RUSSELL, of the University of Michigan, was obtained the use of the original specimen of *Lyrodictya Romingeri* and a few others belonging to the museum of that institution.

From the American Museum of Natural History, through Prof. R. P. WHITFIELD, was received on loan all the material representing the DICTYOSPONGIDÆ in the Hall collection together with that utilized by this author as the basis of his published determinations.

Through Prof. J. F. KEMP, of Columbia University, the specimens from the lower Carboniferous rocks of Ohio, collected by the late Dr. J. S. NEWBERRY and belonging to the museum of that institution, were kindly loaned.

Interesting specimens from the Chemung and Waverly groups, which have been utilized in our illustrations, were obtained from the Peabody Museum of Yale University through the favor of Prof. C. E. BEECHER.

Some important specimens from the Utica slate, fully discussed herein, have been received from the National Museum at Washington, by the courtesy of Mr. CHARLES SCHUCHERT and the late Dr. G. BROWN GOODE.

Prof. ALBERT A. WRIGHT, of Oberlin College, generously loaned specimens from the collections of that institution, among them a very large and interesting example of the rare genus HYPHANTÆNIA.

Through the favor of Prof. E. W. CLAYPOLE, of Akron, Ohio, was obtained the original specimen of *Cleodictya Claypolei*.

The Rev. J. H. MCKEE, of Olean, has permitted the examination and use of Chemung sponges in his own collection and that of the Olean Society of Natural Science.

The delineation of the accompanying figures has been largely done by Mr. GEORGE B. SIMPSON, who has produced them in a highly skillful and artistic manner. Some of the earlier figures were made by Mr. EBENEZER EMMONS. The illustrations of spicules are from camera drawings by Mr. CLARKE.

The lithographic work has been admirably executed by Mr. PHILIP AST.

In the correction of the proof sheets much assistance has been rendered by Mr. JACOB VAN DELOO.

To the persons mentioned and to all others who have been of assistance to the work, I offer the assurance of my obligation and consideration.

JAMES HALL.

Professor JAMES HALL died on August 7th, 1898, at the great age of nearly eighty-seven years. At the time of this lamentable event only a few pages of this memoir had been printed, but his lively interest in the work which owes to him its inception, and his pride in its accomplishment, will always associate his name with present and future knowledge of these remarkable organisms, the DICTYOSPONGIDÆ.

JOHN M. CLARKE.

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THE PALAEOZOIC RETICULATE SPONGES

CONSTITUTING THE FAMILY

DICTYOSPONGIDÆ.

INTRODUCTORY.

Preliminary Remarks. The purpose of this work is to present an account of some palaeozoic forms of an extinct group of organisms, representing the "glass-sponges" of existing seas. Certain simple structures known as PROTOSPONGIA which occur in the Cambrian and early Silurian faunas, have for many years been looked upon as examples of such siliceous sponges, notwithstanding the fact that their skeletons have been wholly replaced by other substances, but until a comparatively recent period the interesting division of these fossils here designated as a distinct family, was unknown or unrecognized as sponges in palaeozoic faunas. The earliest form recorded was looked upon by its discoverer, Mr. T. A. CONRAD, as a cephalopod shell, and was so described in 1842, under the name *Hydnoceras tuberosum*. This specimen was from the Chemung rocks of Steuben county, N. Y. At the same date, a wholly distinct form from the same geologic formation was described by Mr. LARDNER VANUXEM as *Uphantœnia Chemungensis* and was regarded by him as a marine plant. This interpretation of the nature of such bodies became current for the time, and was expressed in the term *Diciyophyton*, which was subsequently applied to several species from the upper Devonian and Waverly horizons. Although the species which had been described up to the year 1880, manifested considerable diversity of form, their condition of preservation did not readily suggest their real nature. In all instances the delicate skeleton of the sponge had been dissolved and had disappeared, leaving only internal and external casts of the bodies with more or less distinct impressions of the spicular network. Such markings were believed to be comparable to those occurring in some of the living marine algae and this similarity, in the absence of any recognized agreement with other known organisms, was the basis of the interpretation of their nature as then made. The discovery of bodies of a similar character in the calcareous shales of lower Carboniferous age at Crawfordsville, Indiana, revealed a spicular skeleton, all the parts of which had been changed to iron pyrites, but were not otherwise materially modified. The study of this material elicited the first definite evidence of relationship of these bodies to

the reticulate siliceous sponges, an opinion which all later investigations have tended to confirm.*

All that is now known with reference to this family of the siliceous sponges, the DICTYOSPONGIDÆ, has been brought together in this volume. The last ten years have vastly increased the number of known forms and demonstrated that in certain late Devonian and early Carboniferous faunas they were abundant in individuals, species and genera. The accounts of the species previously described have been for the most part brief and either insufficiently illustrated or entirely without illustration. In addition to the representation here given of the general aspect of these forms, there is added, where the material permitted, a microscopic analysis of the spicular skeleton.

General Observations on the Sponges.

The Sponges, with the exception of a few forms inhabiting fresh waters, are marine animals, and among the lowest and simplest in the scale of life. Less simple than the Protozoa, they are also of less complicated anatomy than typical Cœlenterata (anemones and corals), and there is an inclination among some later investigators to recognize them as a distinct sub-kingdom of the animal world.

Anatomy. A sponge is an aggregation or colony of simple cells; a mass of connective tissue lined without and within by obscurely differentiated layers. Together, these usually form a sac-like body, attached at the lower or closed end, and to its interior cavity (*paragaster*) the water has free access by means of canals, extending from the exterior surface and opening upon the walls of the paragaster. The course of the water currents is, thus, centripetal over the general surface of the sponge, and centrifugal from the paragaster through the *osculum* or mouth of the sac.

Among the cells of the outer epithelial layer which lines all the canals leading into the internal cavity, are scattered numerous flagellate cells, by the action of whose long "whip-lashes" the flow of nutrient water currents is produced and determined. Such flagellate cells are aggregated in little

* Previous to 1881 there had been only vague suggestions of the sponge-nature of these fossils. The clew to their real character was first furnished by the introduction into the museum collections of this country of the exquisite glass-sponge known as the "Venus flower-basket" and described by the late RICHARD OWEN as *Euplectella aspergillum*. Although this description dates as far back as 1841, the species was a very great rarity in collections here until fifteen or twenty years ago. About that time the sponge fishers of the Philippine Islands, the seas of which are the favorite habitat of the species, glutted the market, so that in England, according to Sir WYVILLE THOMSON, the price of good specimens fell at once from five pounds to ten shillings or less (*The Atlantic*, p. 136, 1878).

chambers within the fleshy part of the sponge wall; to them run the inhalent canals (*epirrhysa*) from the external surface of the sponge, and from them depart the exhalent canals (*aporrhysa*) emptying into the paragastral cavity, through apertures termed *ostia*. All skeletal structures belong to the connective tissue, that is, the median layer.

Such, in brief, is the essential structure of the typical sponge, and from this type there are no departures so extreme as to obscure comparison with this standard. In the simplest sponges, as the *Ascones*, the wall is thin and there are no special chambers where the ciliary cells are aggregated. The entire surface of the paragaster, however, is covered with these flagella. It seems highly probable that a similar condition prevailed among the ancient thin-walled hexactinellids, which are here under consideration. SCHULZE states that while he could not determine the existence of flagella in the hexactinellids on account of the smallness of the cells, he believes that they exist. (Challenger Expedition, *loc. cit.* p. 23.)

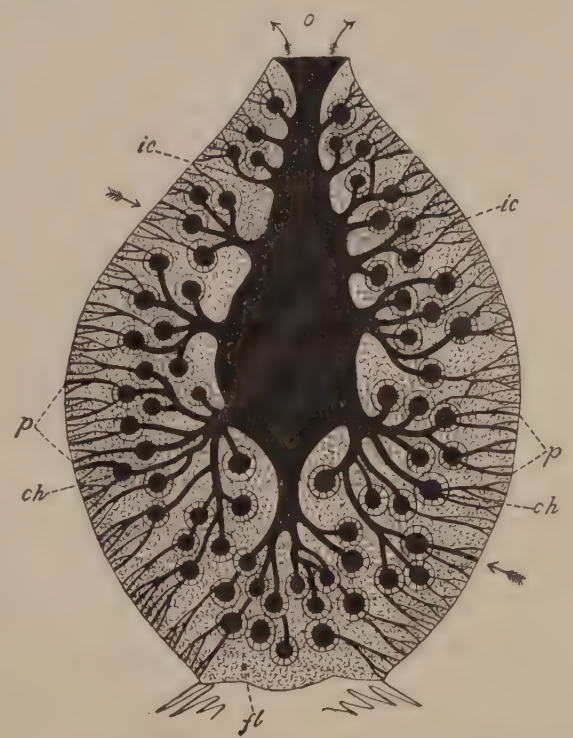

FIGURE 1. Diagrammatic figure showing the structure of a simple sponge in vertical section. The sponge substance (*fl*) is lightly shaded. The canal system is black, the arrows showing the direction of the currents. *pp*, are the pores or openings of the inhalent canals (epirrhysa) which lead to the flagellate chambers, *ch*. From the latter depart the exhalent canals (aporrhysa), *ic*, which open into the general central cavity or paragaster. *o*, is the osculum or aperture through which the water is discharged. (HAECKEL.)

Fixation is an not invariable character. There are, for example, certain ball-shaped lithistid sponges, like the palaeozoic ASTYLOSPONGIA and HINDIA, which appear to have been unattached and the sport of the water currents. These sponges, too, as well as others which are attached, present a concentric arrangement of the water canals which, according to RAUFF, have originated from the ramified furrows of the external surface and have eventually become internal by progressive over-growth of the sponge in concentric layers. Such concentric canals parallel to the periphery of the sponge, are simply large conduits receiving the external water through a great number of minute, converging epirrhysa and debouching in the small paragaster near the summit of the sponge.

Form. Sponges assume an endless variety of expressions of a sac-shaped body. Aside from inherent specific traits, which express themselves most forcibly in such variations, there are numerous external conditions which superinduce modifications in form, even within the limitations of a species. Irregularities in growth may arise from the sponge receiving more nutriment on one side than on the other, and differences in the aspect of individuals belonging to the same species are found to be due to the fact that some have grown in quiet waters and others where the water was in motion. The existence of such variability, which is corroborated by living sponges, can not fail to embarrass the discrimination of specific values among fossil forms. The Dictyosponges present some interesting examples of such *polytrope* species. The *Hydnoceras tuberosum*, Conrad, is a vase-shaped, sub-prismatic sponge, with several horizontal rows of strongly tufted and pointed nodes, and all Dictyosponges having these characters might very conveniently be referred to this specific type. We know, however, the location of several plantations or colonies of these sponges on the sea-bottom of the Chemung period, and have endeavored to make it apparent in the ensuing descriptions, that in each of these colonies the individuals have an expression which characterizes the members of that colony alone. These are distinctly local expressions, due to restricted variability, and they serve to indicate in several instances, the precise spot where they have grown.

Individuality. Sponges may assume either a simple or a compound form; growing as a single sac which never branches or divides, or as a bush-like stock increasing its branches by the production of buds. The compound mode of growth is rare among the siliceous sponges and there is no satisfactory evidence that in the family DICTYOSPONGIDÆ there was ever a tendency to duplication of the sponge by budding. The species *Mastodictya osculata*, of the Keokuk shales, requires further investigation in this respect, as it is not well understood. But as a whole these ancient sponges have rigorously maintained their individuality, so far as that term is permissible in application to a single skeletal structure.

Mode of attachment. The vast majority of all sponges, recent and extinct, have a portion of the body more or less distinctly specialized for fixation. This attachment may be to solid extraneous bodies, rocks, pebbles, dead or living shells, or may be effected by the simple penetration of muddy or sandy sediments by the long, stout fibers of the skeleton.

Recent species and the later fossil forms show that fixation may be effected either by the base (*basiemphytic*) or by one side (*pleuremphytic*) of the sponge. The ancient sponges were largely, indeed almost exclusively basiemphytic. This term, however, is quite general, as basal attachment is effected by several special appliances (*lophophytes*). Some basiemphytic sponges spread their substance over the opposing surface so that the basal part may be of greater diameter than the superior portions of the sponge and show no difference therefrom in spicular composition. In others, such as POLYLOPHUS, tufts of spicular threads from the lateral lobes curve downward, and are interwoven into a short basal rope; while in PHERONEMA attachment is attained by means of several distinct basal tufts. In EUPLECTELLA the strong vertical threads of the skeleton terminate below in a tuft of fibres which constitutes the tip of the elongate obconical body. HYALONEMA possesses a long twisted rope of thick strands, HOLASCUS and DICTYOSPONGIA have shorter, untwisted basal bundles. In THYSANODICTYA and PHRAGMODICTYA attachment was effected by means of a frill or collar (*periloph*) encircling the truncated base, and in the latter genus appearing to have been aided by a small tuft extended from the basal diaphragm. The Devonian Dictyosponges, HALLODICTYA, ACTINODICTYA and CRYPTODICTYA, were either spreading forms encrusting the surface upon which they grew, or pleuremphytic sponges attached by specialized processes yet unknown. There are many forms among the Dictyosponges whose mode of life must have been like that of EUPLECTELLA, buried in the mud or sand for a considerable portion of their length. Such are DICTYOSPONGIA and the long, slender, annulated horns of CERATODICTYA.

The composition of the sponge-skeleton is generally regarded as of fundamental significance in the classification of the entire division, and the combination of the skeletal elements, the shape of their component parts and their mode of union, are highly essential taxonomic characters. The proper understanding of the fossil sponges is, therefore, greatly embarrassed by the usual mutilation and destruction of the skeletal parts, or their modification by the process of fossilization. This knowledge can be acquired only by most patient investigation of the best preserved material.

Since this work does not deal with the ceratose or calcareous sponges they may be left out of present consideration.

THE SILICEOUS SPONGES — *Skeletal Structure.* The structure of the siliceous sponges is simple, though often difficult to elucidate on account of the isolation of a part or all of the spicular elements. The siliceous sponges are either thick or thin-walled. In the former the considerable substance of the cup permits a full development and differentiation of the external, medial

and internal parts of the skeleton, while in the thin-walled sponges these different parts are necessarily condensed, and probably abbreviated or only partially developed. Thick-walled siliceous sponges are not of infrequent occurrence in the earlier faunas, but all the DICTYOSPONGIDÆ and their most closely allied groups, possessed a very thin, almost lamellar skeleton in which a distinction between the dermal and gastral surface is not always clearly perceptible. The accompanying figure which is adapted from one by F. E. SCHULZE, will convey a conception of the disposition of the parts of the skeleton in the thick-walled siliceous sponges. It may be presumed that a

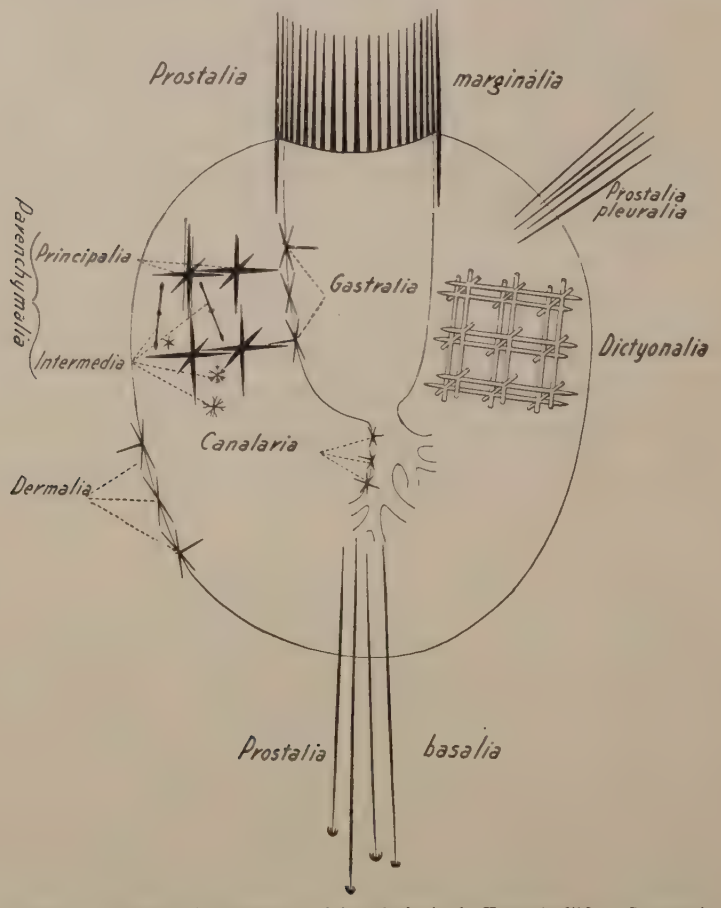

FIGURE 2. Diagram of arrangement of the spicules in the Hexactinellida. (SCHULZE.)

corresponding relation of parts exists in the thin-walled sponges but it is not often possible among the fossil species to distinguish the precise position of the isolated spicules in the skeleton. The most conspicuous and strongest parts of the skeleton are the long rods or smooth spicules projecting from the surface of the cup. These are known as the *prostalia*. They may form a root-tuft at the base of the cup (*basalia*) as in many species both of fossil and living forms, and in such cases they are sometimes furnished with a means of attach-

ment to the sediment in the form of a minute anchor at the extremity of each rod. Such root-spicules are not always present but it would seem that in most of the DICTYOSPONGIDÆ they have been more or less highly developed. About the aperture or osculum there may also be a series of *prostalia*, known as the *marginalia*, which may be present or absent in the thin-walled sponges. At intervals over the lateral surface of the sponge there may be tufts of *prostalia*, such as frequently occur in the DICTYOSPONGIDÆ; these have been termed *pleuralia*. The DICTYOSPONGIDÆ in common with the closely allied family EUPLECTELLIDÆ, also possess horizontal and vertical series of smooth rods in bundles of greater or less size. These cross each other at right angles and produce a reticulated surface which is a leading characteristic of the entire group. The regularity and uniformly descending order of this reticulation is a marked character of these sponges. The regularity of the meshes is, indeed, a feature shared with the PROTOSPONGIDÆ, but in that family there is no such multiplication of the meshes by subdivision as occurs in the Dictyosponges. Though this gradually descending subordinate reticulation is seen in all true members of this family, it has not been determined that the descending series of intersecting spicular bundles which produce the mesh-work are always of a definite number. If, in non-prismatic species, the uniformly largest prevailing quadrule be fixed upon as that produced by the primary spicular bands (THYSANODICTYA, CLATHROSPONGIA) or, in prismatic forms, by the bands lying on the prism angles and intersecting with equidistant horizontal bands (PRISMODICTYA, HYDNOCERAS), it is found that there is a sub-division of the primary quadrule, or *mere*, to the fifth degree; that is, there is a descending series of six sets of reticulating bands, forming quadrules which, in terms of the primary quadrule, or mere, may be designated as *dimeres*, *trimeres*, *tetrameres*, *pentameres* and *hexameres*. Only in rather unusual instances of delicate preservation are the ultimate quadrules, or hexameres, retained. Such reticulation is a quite uniform character of the majority of the genera of these sponges, but there are instances, seen in such genera as PHYSOSPONGIA, ROEMERISPONGIA and HYPHANTÆNIA, in which the uniformity of this gradation is lost; and where there is a single or double series of major quadrules whose surface is covered by an exceedingly minute reticulation (PHYSOSPONGIA) or, possibly, by none at all (ROEMERISPONGIA, HYPHANTÆNIA).*

*The fine reticulation of the major quadrules in PHYSOSPONGIA seems, as elsewhere observed, to be due not to intersecting spicular threads or bundles, but largely to regularly arranged hexactins of the parenchyma; while there are good reasons for regarding the apparently uncovered quadrules in ROEMERISPONGIA and HYPHANTÆNIA as due to the imperfect retention of this delicate layer.

The fossil species show that these fascicles of rod-like spicules lie upon the paragastral surface and a given spicule is often continuous from one extremity of the sponge to the other. It seems evident that these spicules have no connection with the *basalia* and *marginalia*, though the latter are continued into the substance of the sponge and may extend through to the paragastral surface. In the living EUPLECTELLA, the ground work of the skeleton is of similar character, and students are generally agreed in regarding the cylindrical rods composing the horizontal and vertical bundles as modifications of cruciform spicules, due to extreme prolongation of the rays of one axis and the complete suppression of the others. In the Dictyosponges these fascicles sometimes include rods terminating in anchors, and others with a series of barbs along the sides (*clemes*); a fact which may tend to corroborate the derivation above assumed. Under this interpretation these rod-like spicules are of different nature from the *prostalia*; as they are evidently gastral in position they are properly termed *gastralia* and may be distinguished from less modified gastral spicules lying in the interspaces of the network by the term *gastralia lateralia*. Such rod-shaped spicules when clearly preserved in pyrite show very distinctly a tubular axial cavity about which the substance of the rod is arranged in concentric bands or envelopes. Other spicular elements of the Dictyosponges such as have been clearly made out, can be referred to the outer surface of the cup (*dermalia*) and there are a few which it may be safe to regard as representing the medial layer or parenchyma of the thick-walled sponges (*parenchymalia*). The variations in the spicular composition of the skeleton will be considered at greater length in following pages.

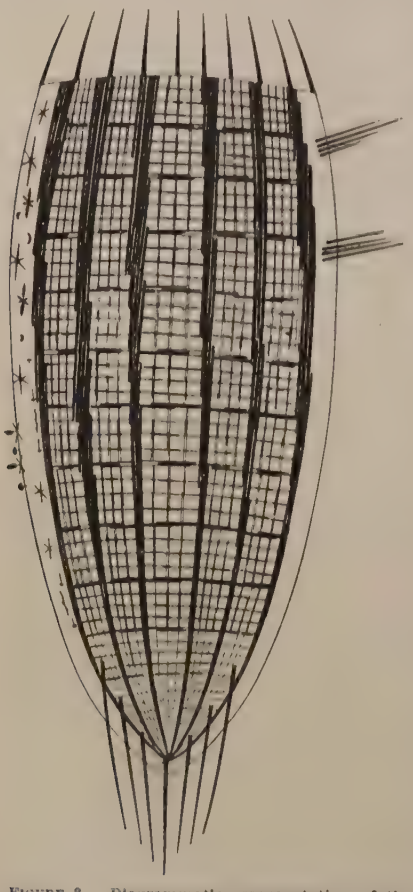

FIGURE 8. Diagrammatic representation of the arrangement of the spicular parts in a typical Dictyosponge.

Taxonomy. The siliceous sponges constituting the Class SILICEA, (GRAY, 1867), or those whose skeleton is essentially composed of siliceous spicules*, are divided into three orders, based upon the form of the

*Recent writers (cf. RAUFF, *op. cit.*) include in the *Silicea*, the ceratose or horny sponges.

fundamental spicule in each. These are the (1) **Hexactinellida,** (2) **Tetractinellida,** (3) **Monactinellida**; in which the predominating spicule, whether its form be unmodified or derived, has respectively six rays, four rays and but a single ray.

In the **Hexactinellida** (OSCAR SCHMIDT), the normal form of the spicular element is a six-rayed star whose rays are of equal length and lie in three planes at right angles to one another. These spicules are termed, with reference to the rays, *hexactins*, or referring to the three mutually perpendicular axes, *triaxons;* from the latter term the name *Triaxonia* was applied to the order by SCHULZE. The variations in the form of the normal hexactins are manifold, spicules with five, four, three and two rays being not infrequent, but it is believed that all are derivatives from, or modifications of, the triaxial type.* These spicules are either isolated and independent, lie side by side forming fascicles, or are coalesced at their extremities forming a continuous network. Two important subdivisions of this order have been generally recognized, (1) the **Lyssacina** and (2) the **Dictyonina**. The former is characterized by the isolation of the spicules which are held together only by the sarcode of the sponge or, in rare instances, by a loose and irregular deposit of siliceous matter; in the latter every arm of each hexactin is united with the corresponding arm of an adjacent spicule, the skeleton thus formed consisting of a frame-work with cubical meshes.

The forms here embraced under the designation DICTYOSPONGIDÆ belong wholly to the suborder *Lyssacina*. So far as their spicular skeletons have been acertained they afford no evidence whatever of the continuous network which characterizes the *Dictyonina*.

Symbiosis. Very interesting instances of commensalism occur in some of the living hexactinellids. A well-known case is that of the gorgonian coral, *Palythoa fatua*, which encrusts the glass rope of HYALONEMA. Another is that of the crab inhabiting the paragastral cavity of EUPLECTELLA, in which it is imprisoned by the reticulum. As it is stated that the terminal sieve-plate is not developed in the early stages of EUPLECTELLA, the crab evidently spends only a portion of its existence thus incarcerated. In regard to this commensal, J. E. GRAY has written:† "The crab is generally found in the cavity of the sponges. The Spaniards in Manila regard them as formed by the crabs for their protection and they do not consider a specimen perfect unless a crab is contained therein. I have, within the last few days had a pair offered to

*See RAUFF, *op. cit.* p. 187; THOMSON, *The Atlantic*, vol. 1, p. 141; and others.
†Annals and Magazine of Natural History, 3d ser. vol. 18, p. 489, 1866.

me for an extravagant sum (£200), because they contained the crab that formed them." Sir WYVILLE THOMSON relates similar facts * and adds: "It is singular that while *Palythoa fatua* is as constantly associated with examples of HYALONEMA from the coast of Portugal as with those of Japan, no commensal crustacean has been found in any of the Atlantic specimens of EUPLECTELLA." DÖDERLEIN has described † a Japanese lithistid sponge having a surface covered with small protuberances within each of which dwells a cirripede of the genus ACASTA. The little crustacean communicates with the outer world through a small opening in the reticulum which is closed at its death.

Among the DICTYOSPONGIDÆ we have observed several instances of vermiform tube-fillings complicated with the impressions of the reticulum and distinctly pronounced on the internal casts of the sponges. These tubes are shown in the figure of *Hydnoceras tuberosum*, var. *glossema*, on Plate IX (fig. 2), and in the illustration of *Prismodictya telum*, on Plate XVII (figs. 3, 9, 10). In all probability these markings indicate the presence of an annelid symbiotic with these sponges.

Affinities of the Dictyospongidæ.

In seeking a proper definition of the family DICTYOSPONGIDÆ, it is necessary to consider its relations to, and differences from the other admitted families of the Lyssacine sponges. On account of the insufficiency of knowledge concerning the spicular structure of these fossils, but few serious attempts have been made to establish their systematic position. HINDE, in 1883, regarded them as *Dictyonina*, and placed the genus DICTYOPHYTON in the family STAURODERMIDÆ;‡ in 1887,§ he included that genus in his proposed family PROTOSPONGIDÆ. These opinions were, however, based upon internal sandstone casts in which all traces of the spicular elements had been obliterated.

RAUFF has defined the family very satisfactorily,¶ placing it among the *Lyssacina*. His characterization of it is in the following terms: "Funnel-shaped, cylindrical or prismatic sponges with thin walls, often raised into nodes or ridges; skeleton very regularly reticulated, forming, as in the PROTOSPONGIDÆ, quadrate or sub-quadrate meshes of different series, enclosing one another. The frame-work is composed of bundles of fine spicules, but whether these spicules are stauractins ‖ with their rays lying

* The Atlantic, vol. 1, p. 141, 1878.

† Zeitschr. für wissensch. Zoologie, vol. xl, 1840. See also RAUFF, Palaeospongiologie, part 1, p. 140.

‡ Catalogue of the Fossil Sponges of the British Museum, p. 130, 1883.

§ Monograph British Fossil Sponges, p. 90.

¶ Palaeospongiologie, p. 189, 1893.

‖ The terms "stauractins" and "cruciform spicules" are used interchangeably for any hexactine spicules showing evidence of branches.

close together, or are diactine rods (with triaxial foundation), or a combination of both, is not yet certain. Very small but distinct stauractins are present. [Sometimes with terminal sieve-plate (?)]." Although the characters of the family can now be stated with greater precision, still the above definition serves to indicate the structural features which distinguish this from other groups of Lyssacine sponges.

The family PROTOSPONGIDÆ, founded by HINDE and somewhat restricted by RAUFF, includes a number of Cambrian and lower Silurian forms (PROTOSPONGIA, Salter, DIAGONELLA, Dawson, PHORMOSELLA, Hinde), in which the very thin net-work consists almost exclusively of a single layer of cruciform spicules which lie at the angles of the quadrate meshes, their rays forming the sides of the meshes, but according to RAUFF, not overlapping to form fascicles. In these species all the subordinate series of meshes are similarly formed. In addition to the regular hexactins or pentactins of the reticulum there are also prostalia in the form of a few strong root-threads; sometimes there is a row of short rods about the margin of the osculum. Small lateral surface rods (pleuralia) are also present in some instances. These structures are shown in the species from the Little Metis slates described by Sir WILLIAM DAWSON,* *Protospongia mononema*, *P. tetranema*, *P. coronata*, etc., and it appears from an examination of some of this very interesting material that the cruciform spicules may extend so far as to overlap one another, and also that there are present a few filiform spicules lying along the axes of the stauractins. In some of these sponges, (*Diagonella coronata* and *D. cyathiformis*, Dawson) the meshes are not bounded by vertical and horizontal sides but are arranged in oblique rows. Recognizing these as characters of the PROTOSPONGIDÆ, it seems somewhat difficult to find substantial belief in the usefulness of the proposed family PLECTOSPONGIDÆ, Rauff,† which appears from the description to have for its principal characteristic the formation of spicular bundles by the overlapping of the filiform rays of the stauractins, together with other rod-like spicules. Dr. RAUFF distinguishes in the skeleton a dermal layer which can not be discovered in the PROTOSPONGIDÆ, but is always clearly defined in the DICTYOSPONGIDÆ. CYATHOPHYCUS, its best known genus, also shows evidence of large circular mural openings, as

*New Species of Fossil Sponges from the Siluro-Cambrian at Little Metis on the Lower St. Lawrence; Trans. Roy. Soc. Canada, vol. vii, Sect. iv, pp. 31–55, figs. 1–27, pl. iii, 1889.

†It may be observed that this name has not been formed strictly in accordance with the rules of nomenclature. There is no genus PLECTOSPONGIA and there should not, therefore, be a family termed PLECTOSPONGIDÆ. The type of the family is not specified but it is evident that the *Cyathophycus reticulatus*, Walcott, has furnished the conception of family characters, although the group also includes the genus PLECTODERMA, Hinde.

seen in the figures of the species given on Plate I. They increase the similarity of these sponges to the living EUPLECTELLA, in which such openings are the vacant or unobstructed portions of quadrules formed by the primary pentactins and the rectangular intersection of the spicular bundles, rounded at the angles by the encroachment of irregularly branching filigree work.

The beautiful specimens of CYATHOPHYCUS which have been found in great abundance in the Utica slate at Holland Patent, N. Y., have been the means of affording a pretty clear conception of the structure of this sponge, and the fine figures given by RAUFF, supplemented by those here introduced for comparison with the Dictyosponges, show the details of its composition. Upon consulting figure 10, Plate I, which represents a large and finely preserved example of this species, somewhat conventionally but judiciously restored in parts, it will be observed that the mural openings may be crossed by the larger cruciform spicules of the outer layer (which is not true of EUPLECTELLA), but they are principally outlined by a pyritized film which appears to be spicular, though not readily resolvable. These characters are better shown in figure 12, which is an enlarged view of a portion of another specimen. CYATHOPHYCUS* possesses a tuft of short root spicules, and *Cyathospongia Quebecensis*, Dawson, has been represented as having free prostalia both about the aperture and over the outer surface of the wall.†

Plate I bears a number of figures representing another interesting species from the Utica slate, occurring in association with *Cyathophycus* (*Cyathodictya*) *reticulatus*, in which the mural openings are numerous and very clearly defined, lying on the inner wall of the sponge and being surrounded by a highly irregular network of cruciform spicules. The form and structure of this sponge suggests little relation to *C. reticulatus*, but again illustrates the occurrence of mural areoles which open through the inner wall of the sponge, but are crossed or obstructed by the stauractins of the outer wall.‡

*This name has been hitherto retained although, like DICTYOPHYTON, it tends to perpetuate the old and erroneous conception of the algous nature of these fossils. DAWSON proposed to modify the term to CYATHOSPONGIA, which would have been an appropriate substitute, had not the name already been in use for a genus of thick-walled sponges. CYATHODICTYA would be in better harmony with the terminology in this group.

†After examination of specimens of this species from the Little Metis slates, it seems that the simplicity of the reticulum and the absence of mural openings, ally it more closely with the species which Sir WILLIAM has referred to PROTOSPONGIA, rather than to CYATHOPHYCUS (CYATHODICTYA) which it resembles only in form.

‡Mr. WALCOTT described from the Utica slate (Trans. Albany Institute, vol. x, p. 19, pl. 2, fig. 17, 1879) as *Cyathophycus subsphæricus*, a flattened, subcircular body, showing no structure, except a small area in the center, which was regarded as an aperture. Dr. RAUFF (*op. cit.* p. 256, pl. iv, figs. 3, 4, 1894) has more recently studied these or similar bodies, and figures them as shallow cups with rather thick walls about the osculum. Only traces of the spicular structure were discerned. Although the composition of these sponges is extremely obscure, RAUFF has proposed for the species the new genus TEGANIUM, and is disposed to include under the specific name *Teganium subsphæricum* the form

The presence of mural openings in these members of the PLECTOSPONGIDÆ, is a feature of similarity with EUPLECTELLA and its allies (EUPLECTELLIDÆ), but in none of the DICTYOSPONGIDÆ is there evidence of precisely similar structures. The DICTYOSPONGIDÆ are distinguished from all of these earlier hexactinellids by the presence of an inner wall, composed of strong vertical and horizontal fascicles of rods reticulating at right angles. In the great majority of instances these reticulating bundles are present in a gradational series, the size of the bundle depending upon the number of rods it contains, rather than upon the size of these rods. In normal forms the series of bundles and, consequently, the series of quadrules made by them, numbers as high as five or even six, the finer reticulation of the sixth series being observable only in instances of the most favorable preservation. There are some genera, however, included within the limits of this family, in which there exists but a single set of reticulating bundles. Thus in PHYSOSPONGIA, there

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described by Dawson as *Protospongia delicatula*, from the Little Metis slates. In the very extensive material representing the Utica slate sponges which has been under examination in the preparation of this volume, similar obscure bodies have frequently been seen. There are however, associated with them, other spherical sponges, showing very distinctly the composition of the skeleton and presenting some highly interesting characters. These bodies in their adult condition and as usually preserved, appear as illustrated in figure 18 (Plate I), that is to say, they are circular disks undoubtedly representing orginally spherical sponges under compression. In no instance has any trace of aperture been observed. These bodies are so broken by the parting of the shaly laminae that almost invariably a portion of the outer wall of the sphere adheres to one side of the matrix, so that figure 18, which represents the usual condition of the fossil, shows, over the circular central portion, the inner wall of the sponge, the peripheral ring being the thickness of the cup to the outer wall. A good exposure of the outer surface is very rarely seen. The inner surface of the sponge bears a great number of clearly defined areoles or mural openings, which are much more closely arranged than in *Cyathodictya reticulata*, and the network by which they are surrounded is highly irregular, devoid of quadrate meshes, though clearly made up of simple stauractine spicules which are involved in not fully resolvable patches of pyrite (see figures 19 and 20). The thickness of the wall as shown in figures 18 and 22 is considerable, the structure being composed of short rod-like spicules which may all be stauractine and the entering arm of the dermal pentactins, but the specimens do not show this conclusively. An entire layer is formed of a single thin lamina of stauractine spicules making a regular quadrate mesh in which the horizontal rays of the spicules may slightly overlap, but no distinct spicular bundles are formed and no filiform rods are present. A portion of this outer layer is shown in figure 20, traces of the mural openings being seen on the matrix beneath it. The entire outer surface is armed with short, erect spicules. Bodies of this character occur in clusters. One slab measuring 18x8 inches bears twenty-seven of them, all of normal size.

The same rock also contains clusters of much smaller circular bodies varying somewhat in size, as shown in figure 16. These also seldom show evidence of an aperture except such as is seen in one of the larger examples in figure 14, and this appearance may be wholly due to the exfoliation of a fragment of the slate. The substance of the smaller of these spherical bodies or disks is an unresolvable mass of pyrite, of similar character to that described by RAUFF for *Teganium subsphæricum*, except that about the periphery are erect spicules of proportionally much greater length than the surface spicules in the large spheres just described (figure 17). With slight increase in size, however, the spicular skeleton with its mural areoles becomes gradually defined, leading to the conclusion that these *Teganium*-like bodies are young of the larger forms. There is still doubt as to the relation of all of these forms to the *Cyathophycus subsphæricus* of WALCOTT and the *Teganium subsphæricum* of RAUFF.* There is little in their structure to suggest the characters of that species given in the analysis by either of these writers, save the spherical form ascribed to it by the former and the obscure spiculization recorded by the latter, notable only in the very young of our specimens.

The generic characters ascribed to *Teganium* fail to apply to these spheroidal sponges, save in part to their youngest stages, and while we can not be certain that Dr. RAUFF may not have had similar bodies before him in the description of *Teganium*, the uncertainty attending the description and illustration given

is good reason to believe that the quadrules made by the large primary fascicles are not subdivided by similar bundles of less size, although an extremely fine reticulation of these areas may be seen, which may be due to regularly juxtaposed stauractins not on the inner wall, but over the outer surface of the sponge.

In the great saucer-shaped fronds termed HYPHANTÆNIA (*malé* UPHANTÆNIA), the broad radial and concentric bands form quadrate areoles which may have been largely or wholly free of spicular structures of any kind. The sandstone matrix in which the few known specimens of this sponge have been found is not favorable for the retention of tenuous spicules, though a similar rock shows at times, the continuity of very fine skeletal films in some other of these sponges. But had there been, over these open quadrules, a coating of fine, isolated dermal spicules, their disappearance rather than their retention would be a reasonable expectation. A single one of the five specimens of HYPHANTÆNIA at present known, shows traces of such a film at the angles of the great quadrules.

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by him, warrants the application of the term SPHÆRODICTYA to the interesting generic type of structure here analyzed.

*The original specimen of *Cyathophycus subsphæricus* is preserved in the Museum of Comparative Zoology at Cambridge. Like the specimens described by RAUFF it shows no evidence of reticulation or spicular structure, nor are there any traces of peripheral spicules. The central area, supposed to be the osculum, is irregular and there are no means of determining whether it is actually such or is only a casual feature.* Upon application to the curator of the United States National Museum at Washington, for authentic specimens of *Teganium subsphæricum* for comparison with the material above described, we have been kindly allowed to examine a portion of the material studied by Dr. RAUFF and identified by Mr. WALCOTT as his species. Of the specimens received, one is a minute cup-shaped body similar in form to those described by RAUFF and with a similarly obscure skeleton; three others are cups of like form but larger size and with a quadrate network already defined; these resemble young individuals of *Cyathodictya reticulata* and all the rest are the small circular bodies with pseudopodia-like peripheral spicules. A portion of a single cluster of these is represented in figure 14, and the enlargement of one of the individuals (fig. 15) shows the clearly defined spicular layer coexistent with the spiny outer wall, while in all the smaller examples the spicules of the skeleton, except those of the outer wall, are not evident. As it was still difficult to apprehend the evidence upon which the determinations made by RAUFF were based, Mr. CHARLES SCHUCHERT, curator of invertebrate palaeontology in the National Museum, was requested to examine the specimens which had been figured by that writer, with especial reference to the following points: (1), Whether the specimens figured by RAUFF in his fig. 4, pl. iv, showed distinct evidence of possessing an aperture, or whether the areas represented as apertures might be exfoliations of the thin pyritized films; (2), whether these three cups are all on the same block and are convex as represented; (3), whether any of these small specimens, when moistened, show a series of peripheral spinules; and (4), whether the larger specimen represented in *op. cit.* fig. 3, has the unresolvable pyrite film and the great aperture, as represented. To these inquiries Mr. SCHUCHERT has, after careful inspection of the material, answered very explicitly: (1), "There is no evidence of an aperture in any of the three small specimens studied by RAUFF. Where these are indicated in the figures there has been a partial or complete removal of the pyritized film in the specimen"; (2), "The three figures given by RAUFF are taken from three separate and distinct specimens so that fig. 4 is ideal. The apertures are drawn in as well as the convexity." (3), "No peripheral spicules can be detected in these specimens." (4), "There is a thin pyritized film which has been varnished over, and in none do I distinguish spicules. The aperture in fig. 3 is also drawn in."

*We have had no opportunity of examining this specimen, but the above statements are based upon an examination kindly made by Prof. ALPHEUS HYATT.

The rods of the vertical and horizontal bundles are for the most part smooth throughout their entire length; they afford no evidence of being stauractine, but, as suggested in the diagnosis of the family given by RAUFF, are apparently extremely elongated diactins. The outer wall of these sponges usually carries a regularly quadrate mesh produced by large pentactins standing at each angle of the quadrules. These outer quadrules usually, though not necessarily, correspond with the varying quadrules of the inner reticulum, and it is not at all certain that the outer meshes are greatly subdivided. This outer or dermal layer may also carry projecting spicules of various forms, spirules, umbrella-shaped clavules and echinated stauractins, which will be more fully described in the following pages. The surface may also bear projecting ornamental lamellae and ridges like those in EUPLECTELLA, and strongly developed tufts of stout rods, as in PHYSOSPONGIA and HYDNOCERAS. To the thin space intervening between the outer and inner surfaces of the skeleton are ascribed some normal hexactinellid and minor modified forms of spicules.

The variations in form independent of essential alteration in structure are most noteworthy. Some of the Dictyosponges are obtusely or acutely obconical with a simple exterior; other obconical forms have a highly nodose and tufted surface with, sometimes, clusters of pendulous pouches; many are distinctly prismatic, some bear strong concentric annulations and vertical ridges, a few have the form of large saucers, others of graceful vases with slender neck and expanded bowl, and in two genera the form is almost cylindrical and has a broad fringe or frill about its flattened base.

One should pause to reflect that these ancient organisms with their manifold variety of graceful and striking shapes, were not the sombre bodies we find them to be in the rocks, but in life formed the most delicately woven fabrics of glass, latticed vases, urns and cups of the rarest delicacy and beauty. They must have been, when denuded of their sarcode, among most exquisite structures of the past, as their descendants are of the the present. Nothing for example, could have surpassed the graceful filigreed chalice of *Botryodictya ramosa*, with its slender, tufted pedicel expanding above into a cup ornamented with pendant pouches.

Forms like those just mentioned as having a flattened transverse extremity, raise an important question as to the existence in these sponges of a terminal sieve-plate like that in EUPLECTELLA. The determination of this point is essential not only to a proper conception of the limitations of the family

DICTYOSPONGIDÆ, but also to a correct orientation of certain of its members. The genera PHRAGMODICTYA and THYSANODICTYA, which are here fully described and illustrated, are subcylindrical sponges having the margin at one extremity regular, unmodified and free; the other extremity is an almost transverse plate, septum or diaphragm which completely closes the cup, and about its edges where in contact with the walls of the cylinder, is a free expansion or frill. In EUPLECTELLA, which is throughout the nearest living representative of the Dictyosponges, there is, at the *upper* extremity a terminal plate, the so-called "sieve-plate," surrounded by a free marginal frill of spicular net-work.* This terminal portion of the skeleton is, however, less a perforated plate than a combination of stout, inosculating rods or trabeculae. It is described by SCHULZE in the following terms: "The watch-glass-like, arched, terminal sieve-plate consists of a lattice-work of laterally compressed ridges of various thickness, which, though exhibiting no very regular arrangement, yet suggests a wheel-like reticular structure. One can distinguish at least three or four main beams which are approximately circular and several which extend radially. These form the primary meshes, which are again divided by narrower and less prominent ridges. Here and there a broader plate is formed in the net-work, as if by the confluence of the stronger beams."†

This structure is in no respect similar in composition to the net-work constituting the rest of the sponge and its beams are not continuous extensions of the ground-work strands of the latter. It appears to be wholly a protective apparatus for the osculum, cemented to the upper margin of the reticulum. The marginal frill in EUPLECTELLA is simply one of the many surface ridges covering the outer wall of the sponge.

In PHRAGMODICTYA and THYSANODICTYA the structure of the terminal plate is wholly different. It is, primarily, a low cone, and is constituted of radial spicular strands which are an immediate continuation of the vertical fascicles of the reticulum, those being crossed by concentric strands, corresponding to the horizontal bundles of the rest of the skeleton. The radial strands converge at or near the center of the cone, and when the outer part of the cone is preserved there is evidence of the existence of a spicular tuft about the apex. Not all the rods of the vertical bundles extend from the body of the sponge into this plate; a portion of them is continued into the broad thin peripheral frill, the surface of which is crenulated, while its distal margin is irregularly fringed by long radiciform extensions. The radial spicules of

*OWEN at first regarded this sieve-plate as at the bottom of EUPLECTELLA (See SCHULZE, *op.cit.* p. 54).
†Challenger Expedition, vol. xxi; Hexactinellida, p. 66.

the terminal plate in these genera, and their continuity with the rest of the skeleton, of itself demonstrates the fact that this is the base of the sponge, and is not in the remotest sense homologous with the sieve-plate in EUPLECTELLA; this evidence is corroborated by the structure of the peripheral frill and its evident adaptation to the purposes of attachment as seen in the character of its distal margin.

From this consideration of the characters of the Dictyosponges and the groups allied to them, may be deduced the following definition of the family:

Family DICTYOSPONGIDÆ, Hall.

Obconical, prismatic, cylindric, explanate, vase, funnel and saucer-shaped, thin-walled sponges, with the inner layer of the skeleton composed of series of reticulating vertical and horizontal bundles mostly of smooth diactine rods; the outer layer composed of regularly arranged stauractins forming quadrate meshes with more or less irregularly disposed spicules scattered over the quadrules thus produced (pinulus, clavules, etc.). Regular hexactins in the parenchyma. Single lophophyte generally present. Periloph, marginalia and pleuralia present or absent. No mural areoles; no terminal sieve-plate.

STRUCTURE OF THE SKELETON.

In contrast to the very considerable generic variation and abundant specific representation now recognized in this family, our knowledge of the spicular elements of the skeleton is, and must remain, very incomplete. This is the more to be regretted, since the structure of this frame-work is the essential basis of taxonomic arrangement. Among the abundant species of the Devonian, this skeleton, almost without exception, is lost, however clear and undisturbed the original form of the sponge and the impression of its surface characters. In the sands and sandy shales of the Chemung group from which the great majority of these sponges has been obtained, the original hydrated silica of the skeleton has undergone change, probably through the agency of organic acids resulting from decomposition, and has been replaced first by pyrite, and by oxidation this has passed into limonite and been quickly removed from the porous rock. In rare instances portions of the spicular rods in the condition of limonite have been seen in specimens from the upper Devonian and more often in those from the sandy layers of the lower Carboniferous (Waverly group) of Ohio. The calcareous shales in which the sponges of the Keokuk group at Crawfordsville and Indian Creek, Indiana, are embedded, have, however, retained a greater or less portion of the

skeletons in a pyritized condition, and it is from this source that all our knowledge of their ultimate composition is derived. As already observed, the frame-work of these sponges consists of bundles of rods crossing at right angles. The majority of these are smooth and taper very gradually, not necessarily extending for the entire length of the sponge. Close observation has not yet shown them to have more than a single axis, that is, they are not

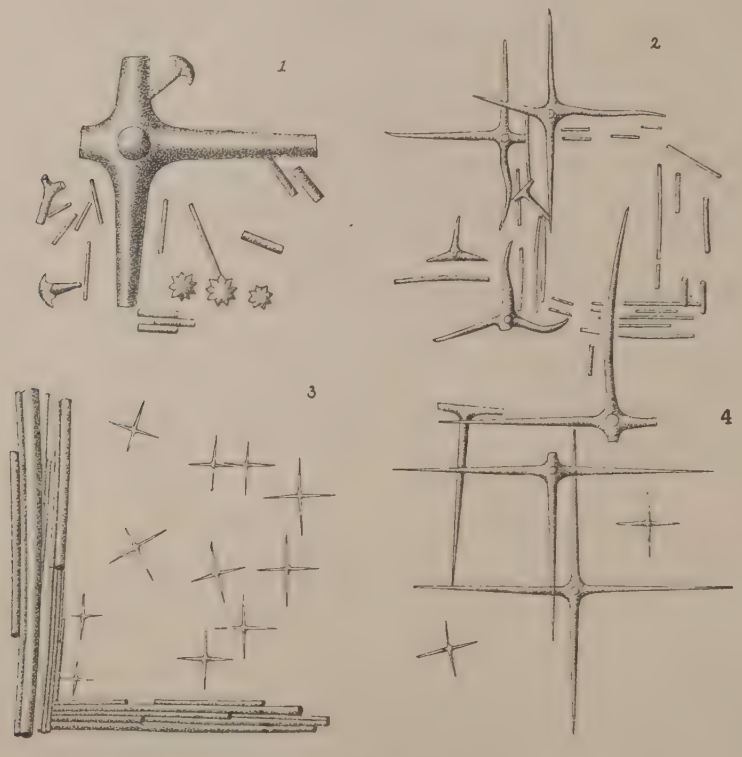


FIGURE 4. Spicules of Dictyospongidæ.

1. Part of a primary pentactin of *Cleodictya Mohri*, with umbels in various positions, and fragments of other spicular rods. x 60.
2. Two angles of a quadrule in *Phragmodictya catilliformis*, the primary hexactins or pentactins being in place, with fragments of the vertical and horizontal bundles. x 50
3. Part of a quadrule, showing the vertical and horizontal bundles with parenchymal spicules scattered over the interspace. x 40. From an undetermined fragment at Crawfordsville, Indiana.
4. Some of the major and minor hexactins of *Dictyospongia ? Marcellia*. x 30.

crossed by other rays. Such rods may, therefore, be regarded as extreme modifications of the typical triaxial or hexactinellid form, produced by the abbreviation of two of the axes. The terminal portion of a very small rod (*Mastodictya osculata*) enlarged 400 diameters, is represented in the accompanying figure 5. In some genera, particularly in PHYSOSPONGIA, vertical bundles of these rods, which lie on the inner or paragastral surface of the sponge, are accompanied by comparatively short rods which terminate in an anchor with two sharp flukes (figure 5). These had nothing to do with the fixation of

the sponge as, in *Physospongia Dawsoni*, they are scattered over the entire length of the principal vertical paragastral strands. The relation of their form to the normal hexactins may be understood by observing that the sides of the head of the anchor not extended into spines are much swollen, forming abbreviated representatives of the rays of the third axis. With these anchorate rods are others, occurring in PHYSOSPONGIA, CLATHROSPONGIA and LYRODICTYA, which may be termed *clemes;* formed of flattened rods with alternating broad triangular processes at the sides (figure 5). The anchorate and clemate rods are found together, but only in the vertical fascicles. The spicules of the outer or dermal wall of the reticulum are seldom retained in place, and the precise position of some of the forms is to a considerable degree a matter of conjecture. Here there are no smooth rods, anchorate spicules or clemes, or if the first are ever present, they are small and of rare occurrence. The mesh of the outer wall is, as already observed, composed of stauractins, principally pentactins, which lie at the angles of small quadrate areas (see figure 4). These pentactins are usually smooth-rayed but not infrequently they bear thorns or long spinules (figure 6 (9)). In these pentactins a single low node near the intersection of the axes is frequently present and represents a sixth ray. The surface of the quadrules set off by the principal pentactins is covered with, or filled by, isolated spicules of various forms. It is not easy to conclude, except from comparison with living hexactinellids, which of these spicules are referable to the dermal layer and what portion of them to the interstitial or parenchymal layer of the reticulum. On account of the thinness of the entire sponge wall, the distinction of such an intermediate layer is perhaps a purely conventional one. It is usually extremely difficult to discriminate between the outer and inner layers of the skeleton especially when under compression, but the

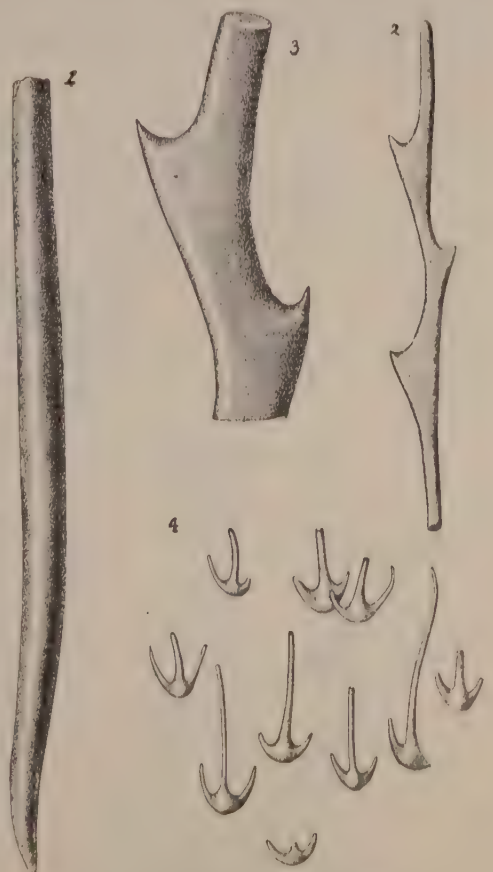


FIGURE 5. Spicules of Dictyospongidæ.

1. Terminal portion of a small vertical rod in *Mastodictya osculata*. × 400.
2. Cleme of *Physospongia Dawsoni*. × 60.
3. Part of cleme of *Aclaeodictya marsupus*. × 100.
4. Group of anchorate spicules, *Physospongia Dawsoni*. × 60.

presence of certain spicules similar to those which, in recent siliceous sponges, are found in the sarcode of the inner layer, is a reason for ascribing such layers to the DICTYOSPONGIDÆ.

To the dermal layer may be ascribed the umbrella-shaped clavules, or umbels, occuring in CLEODICTYA, PHYSOSPONGIA and GRIPHODICTYA (figures 6, 7); short, thick rods with an arched, toothed disk at the end. To the same layers, also, various forms of the pinules, some clearly pentactin, others compound, among them the peculiar *tri-pinulus* which consists of three tufted rays rising from a smooth base with accessory processes (figure 6). These pinules have seldom been found unbroken with the exception of the tri-pinulus, a form occurring in CLEODICTYA and LEBEDICTYA. To the parenchyma (or perhaps to the quadrules of the inner wall) may belong certain peculiar pentactins with curved rays, found only in *Phragmodictya catilliformis* (figure 6 (1-4)) and the pod-shaped diactins which occur in PHRAGMODICTYA, LEBEDICTYA, PHYSOSPONGIA, GRIPHODICTYA, etc., and perhaps also, the highly branched oxyhexasters characteristic of the genus GRIPHODICTYA (figure 7).

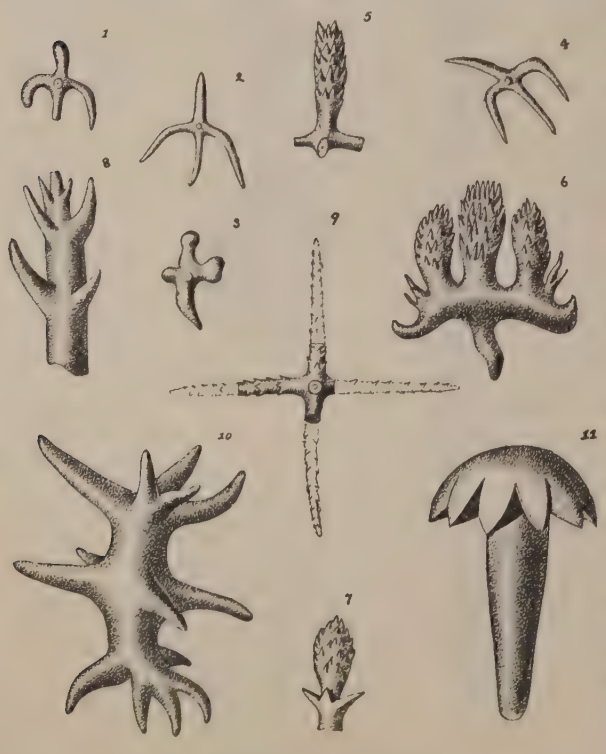


FIGURE 6. Spicules of Dictyospongidæ

1, 2, 3, 4. Modified hexactins of *Phragmodictya catilliformis*. x 400.
5, 6, 7. Different forms of the pinulus from *Cleodictya Mohri*. x 400; 6 is a complete tri-pinulus.
8, 9. Parts of echinate hexactins, also from *Cleo. Mohri*. x 400.
10. A much modified spicule from *Griphodictya epiphanes*. x 400.
11. An umbel; *Physospongia Colletti*. x 400.

The prostalia or tufts of spicular rods occurring at the base, aperture and at various nodes upon the surface of some species, seem to penetrate the entire wall and, in some instances, as in HYDNOCERAS and PHYSOSPONGIA, to bear a definite relation to the intersections of the vertical and horizontal facicles of the inner wall.

NOTE The terminology of the spicular elements of the sponges has in recent years become very complicated through an exuberant growth of terms which do not explain themselves. The present profusion of names is quite bewildering while the fundamental conception of the spicule form is perfectly simple and the mode of its modification not of itself neccessarily

complex. To serve the purposes of this work we have brought together in figure 8 a group of the more characteristic derivative forms of the hexactin spicule, which has been compiled from the illustrations given by SCHULZE (*Report Challenger Expedition*) and RAUFF (*Palæospongiologie*). These will aid in elucidating the spicular forms occurring in the DICTYSPONGIDÆ.

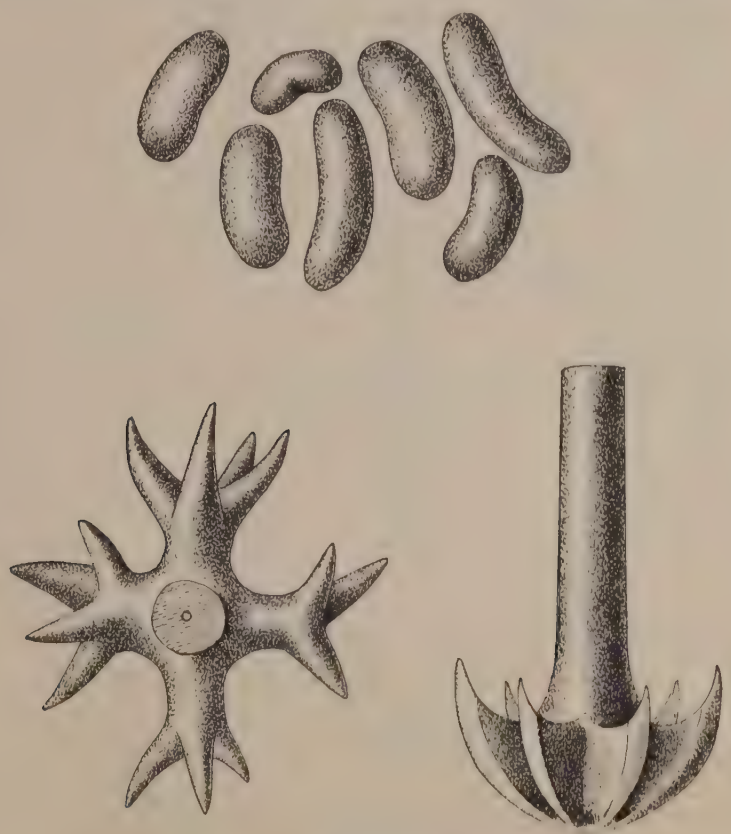


FIGURE 7. Spicules of Dictyospongidæ.

The upper figure is a group of stout bean-shaped diactins from an undetermined fragment at Crawfordsville, Indiana. The two lower spicules are from *Griphodictya epiphanes;* that at the left is an hexactin much branched at the extremityof the rays; that at the right an umbel with deeply cleft top. All x 400.

VARIATIONS AND GENETIC RELATIONS OF FORM.

A glance through the plates of this volume will convey an idea of the multiplicity of forms under which the Dictyosponges manifested themselves. Among these smooth, nodose, prismatic and annulated cups and vases, the smooth slender obcone as expressed in the typical genus DICTYOSPONGIA, is doubtless to be regarded as the fundamental form. The primary relation of this form to all the abundant expressions occurring in the Devonian faunas is evident from an inspection of any well-preserved example of a nodose, prismatic, annulated or other form, in all of which the early stages are

regularly obconical. In HYDNOCERAS this primitive, smooth condition was of brief duration and was directly followed by the development of prism-faces, at first four and directly thereafter eight, the normal number. These prism-faces are well developed before the appearance of the nodes on the prism-

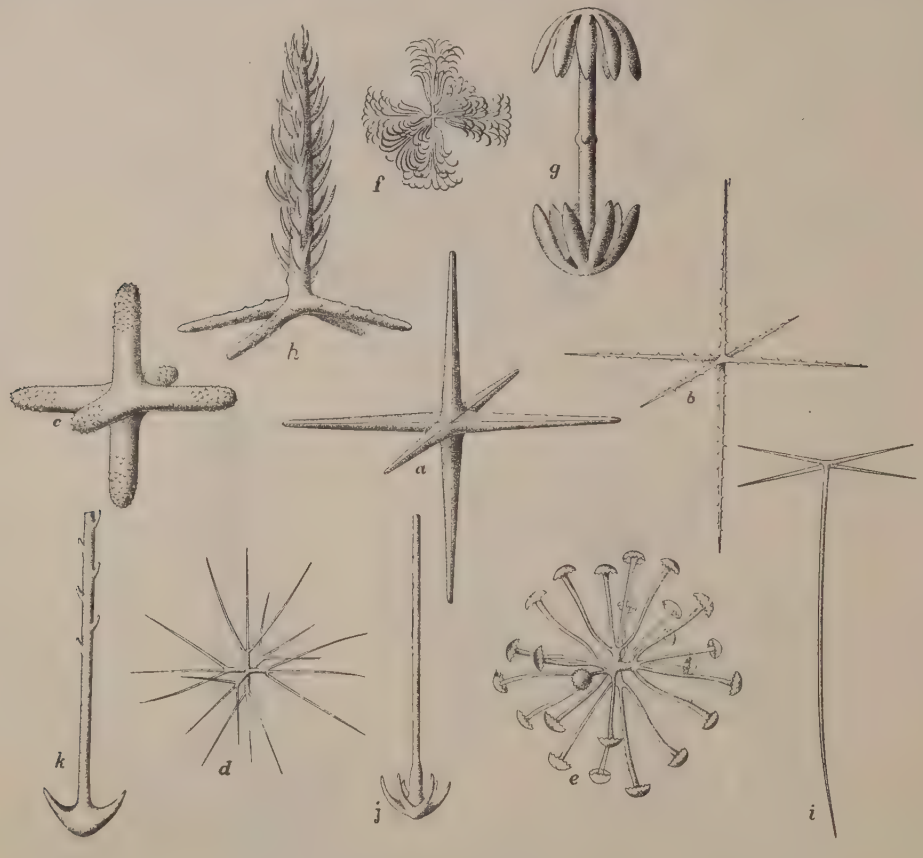


FIGURE 8. Primary and modified forms of the Hexactin.

a. Oxyhexactin, x 100; *b*. Echinhexactin, x 300; *c*. Strongylhexactin with prickly extremities, x 450; *d*. Tylhexaster, x 300; *e*. Discohexaster, x 450; *f*. Plumicome, x 300; *g*. Amphidisk, with remnants of the abbreviated arms, x 100; *h*. Pinule, x 300; *i*. Orthotetraen, x 100; *j*. Clavule, x 450; *k*. Diaen, x 150. (RAUFF.)

angles. The nodes themselves do not appear abruptly but with gradual increase in size, and after the passage of the adult period their size again decreases, and eventually they disappear; the prismatic faces also become obsolete, the apertural portions of old individuals being smooth and funnel-shaped.

The remarkable genus BOTRYODICTYA retains the smooth, primitive, subcylindrical form of the cup for fully one-half its length and then abruptly swells into a vase with obscure prism-faces and an extravagant development of compound pouch-shaped nodes. In the great majority of all of the Devonian species of these sponges the prism-faces are more or less clearly discernible,

even among forms belonging to the genus DICTYOSPONGIA, so that this prismatic form seems in a certain sense normal to the group, though always a progressed condition. In some of the annulated species, as RHABDOSIPONGIA, the annulations are clearly of subsequent appearance to the prism-faces, though the latter are represented throughout the adult condition of the sponge as vertical ridges; while in CERATODICTYA the annulations appear to follow directly upon the smooth conical condition, the prismatic condition not being manifested.

It is a significant fact that even with our present imperfect knowledge of this group, the earliest known Dictyosponge, *Dictyospongia Danbyi*, McCoy (sp.), from the Ludlow beds of England, is such a regularly obconical species with, possibly, an obscure development of the prism-faces toward its upper part. This simple form may be regarded as directly derived from that which characterizes such earlier Silurian forms as CYATHODICTYA. The secondary modifications of this form (prism-faces, nodes, annulations, etc.), are not known in any such early species nor outside of the DICTYOSPONGIDÆ.

Among the many prismatic or banana-shaped species which constitute the genus PRISMODICTYA, the early smooth conical stage is extremely abbreviated, but when specimens are well preserved to the basal apex it is found that such a condition exists.

With the disappearance of the Devonian faunas, the simple prismatic sponges quickly disappear. The introduction of the Waverly fauna, immediately succeeding the upper Devonian in Pennsylvania and Ohio, brought in several new generic types, some of which retain the prismatic form under considerable modification (CALATHOSPONGIA), but in the preponderating species the prismatic structure is essentially lost. THAMNODICTYA and CLEODICTYA are sponges with a smooth surface; the simple, obconical form of the cup is modified in both, in the former the base of the cup being broad and its apertural portion expanded into a wide vase, and in the latter, the bowl-like lower part of the sponge bearing a row of nodes which seem to have no relation to prismatic faces as in all of the nodose species of the Devonian.

The still later fauna of the Keokuk group as represented in eastern Indiana, brings in the remarkable genus PHYSOSPONGIA, a broadly conical sponge with wide base, and having the inner wall of its skeleton constructed on a very simple plan; a modification of the normal type of structure which is evidently foreshadowed in the *Roemerispongia Gerolsteinensis*, F. Roemer, of the middle Devonian of Germany. In this fauna is, also, the genus PHRAGMODICTYA, a non-prismatic sponge characterized by its depressed conical base surrounded by a

peripheral frill; a form anticipated in the THYSANODICTYA of the upper Devonian, in which evidence of the prism-faces is still retained. In the greater number of all the other known species represented by the genera CLEODICTYA, LEBEDICTYA, CALATHOSPONGIA and LYRODICTYA, the form is some modification of a rapidly expanding obcone or vase, like the ultimate expanded apertural portions of the Devonian nodose sponges. With all these generic modifications so unlike those prevailing in the Devonian, are still to be found a few representatives of the genera PRISMODICTYA and DICTYOSPONGIA.

Though the future will doubtless afford much evidence helping to establish the mutual relations of form among the Dictyosponges, the evidence of the present clearly points to the simple, slender, smooth obcone as primitive, probably derived from the antecedent PLECTODERMATIDÆ and PROTOSPONGIDÆ, and attaining its maximum in the upper Devonian; to the prismatic form as a primary derivation therefrom, a group also attaining its highest development in the upper Devonian; to the nodose and annulated forms as a secondary derivation, and the explanate, non-prismatic vase-shaped species with their various modifications, such as prevail in the lower Carboniferous faunas, as a still later derivation from the fundamental type.

MODES OF PRESERVATION.

The skeletal substance of the siliceous sponges is a hydrated or chalcedonic silica. In these fossils, as preserved in the older rocks, this skeleton has been wholly removed and replaced by some other substance.* In a single instance among all the examples here described, *Clathrospongia Hamiltonensis*, from the calcareous shales of the Hamilton group, the skeleton has been substituted by a deposit of carbonate of lime, which retains the general aspect of the net-work though the form and structure of the individual spicular bodies is wholly lost. In all other cases that have come under our observation the replacement of the siliceous skeleton has been a complicated one resulting in the substitution of iron pyrites for the silica, and with such delicacy and so gradually has this process been carried forward, that the minutest details of form in spicules of highly intricate structure have been retained.

Notwithstanding the fact that, almost without exception, in all the numerous sponges of the upper Devonian sandstones, the spicular skeleton is entirely gone, it is evident that its absence is not due to a lack of replacement by pyrites but to a removal of the pyrites itself. This appears from the

* ZITTEL observes that in the older lithistid siliceous sponges the original amorphous, singly refractive silica has become doubly refractive, and almost insoluble in caustic alkalies (*Annals and Magazine of Natural History*, vol. 20, 1877, pp. 260 *et seq.*).

occasional presence in examples from these and the similar sandstones of the Waverly group, of a few root spicules which are in the condition of hydrated oxide of iron (limonite), as well as from the iron stains which frequently accompany much of the material from all such rocks. The porous sandy matrix of both horizons has been an efficient aid to the removal of the skeleton. Where replacement has gone on in the presence of abundant decomposing organic matter, as in the bituminous rocks of the Quebec group, Utica slates and Marcellus shales, the deposition of pyrite is complete and sometimes excessive; so that the form of the spicules may become obscured by pyritous enlargement.

In the calcareous shales of the Keokuk group in Indiana, the pyritous replacement is often retained. The fact that it is not always present but that in the majority of instances it has been lost, leads to the inference that the removal of the pyritized skeleton is constantly in process. It is, however, to the sponges of this horizon that is due such knowledge as we now possess of the ultimate spicular structure in the DICTYOSPONGIDÆ.

Although the sandstones of the Devonian and lower Carboniferous have proven unsatisfactory media for the retention of the skeleton they have well preserved the form of the sponges. They have been, at times, subjected to slight distortion from compression, but this disfiguration is always much less in these rocks than in those more highly laminated and of finer texture. The impressions of the interior and exterior of the skeleton are often so sharply defined as to afford a very clear conception of the structure of the network and the ornamentation of the surface, the slight discoloration of superficial ridges and laminae by iron stains frequently aiding such conceptions. While specific and generic characters in this family are so largely dependent upon variations of form, this mode of preservation is by no means unsatisfactory, as the shape of the sponge is usually better preserved than in more schistose sediments.

HABITAT AND MODE OF OCCURRENCE.

The prevalence of these Dictyosponges in the sandy sediments of the Chemung group is in strong contrast to the distribution of existing hexactinellids over the present sea-bottom. The Chemung formation of the central-western part of the State of New York is essentially a succession of arenaceous beds in the condition of compact sandstones and sandy shales, with occasional layers of argillaceous shale and, toward the upper part of the series, with gravelly conglomerates. In all of these sponge remains have been found, but the occurrence of isolated specimens alone can not be relied upon to determine

the nature of their habitat; for in many instances there is collateral evidence of the sponge having been drifted from its proper position.

The known colonies of these sponges afford more direct evidence. The colony of *Hydnoceras Bathense*, at Bath, lies overwhelmed between banks of sandstone and involved in a few inches of a somewhat arenaceous clay-shale. Its existence was terminated abruptly, as shown by the fact that the great majority of the individuals are confined to a very thin layer at the surface of the sandstone and by the additional fact that all have been greatly compressed. Now it is found that while the exposed surface of these overwhelmed sponges may be covered with the shaly rock, their under surfaces are involved in the sand and, further, occasional specimens are found quite buried in the sandstone stratum itself. It is possible that this extensive sponge plantation grew upon the muddy bottom represented by the thin layer of shale, though the data more clearly indicate that it was rooted on the sandy bottom and was overwhelmed by the influx of mud. A great number of specimens of *Hydnoceras botrœdema* have been taken from the soil on Irish hill, near Bath, and though the rock beds from which they come have not yet been opened, the specimens are uncompressed internal casts in sandstone, both their form and matrix indicating the absence of a muddy sediment. The colony of *Hydnoceras tuberosum* at Brown hill, near Cohocton, that on Hamlin's farm, near Naples, and the one at Cotton hill, near Avoca, in the last of which is a number of diverse species, are all in a soft sandy sediment, which is highly laminated and schistose but is not shaly nor does it show other evidence of muddy bottom except so far as the mud is commingled with the sand. At Cuba, Allegany county, is a small colony of *Dictyospongia sceptrum* which occurs in a heavy sandstone stratum and the sponges have been prostrated not by any change in the nature of the deposit, but rather by the impact of the waves or water currents. This is indicated in the accompanying cut which shows three overthrown individuals lying side by side and parallel, having evidently fallen where they grew.

In other cases there is evidence of considerable admixture of muddy matter in the sediment, as in the colony of *Thysanodictya Edwin-Halli* at Wellsville, where the rock is soft and the specimens in large part compressed; but even here the matrix is still arenaceous and many specimens are without compression. In this plantation from which several hundred specimens have been taken, the sponges are found at times to retain their upright position, thus indicating how gently the sediments have been deposited about them. Fifty miles away from Wellsville, which may be regarded as the geographic center of the most prolific sponge region in the upper Chemung beds, occurs

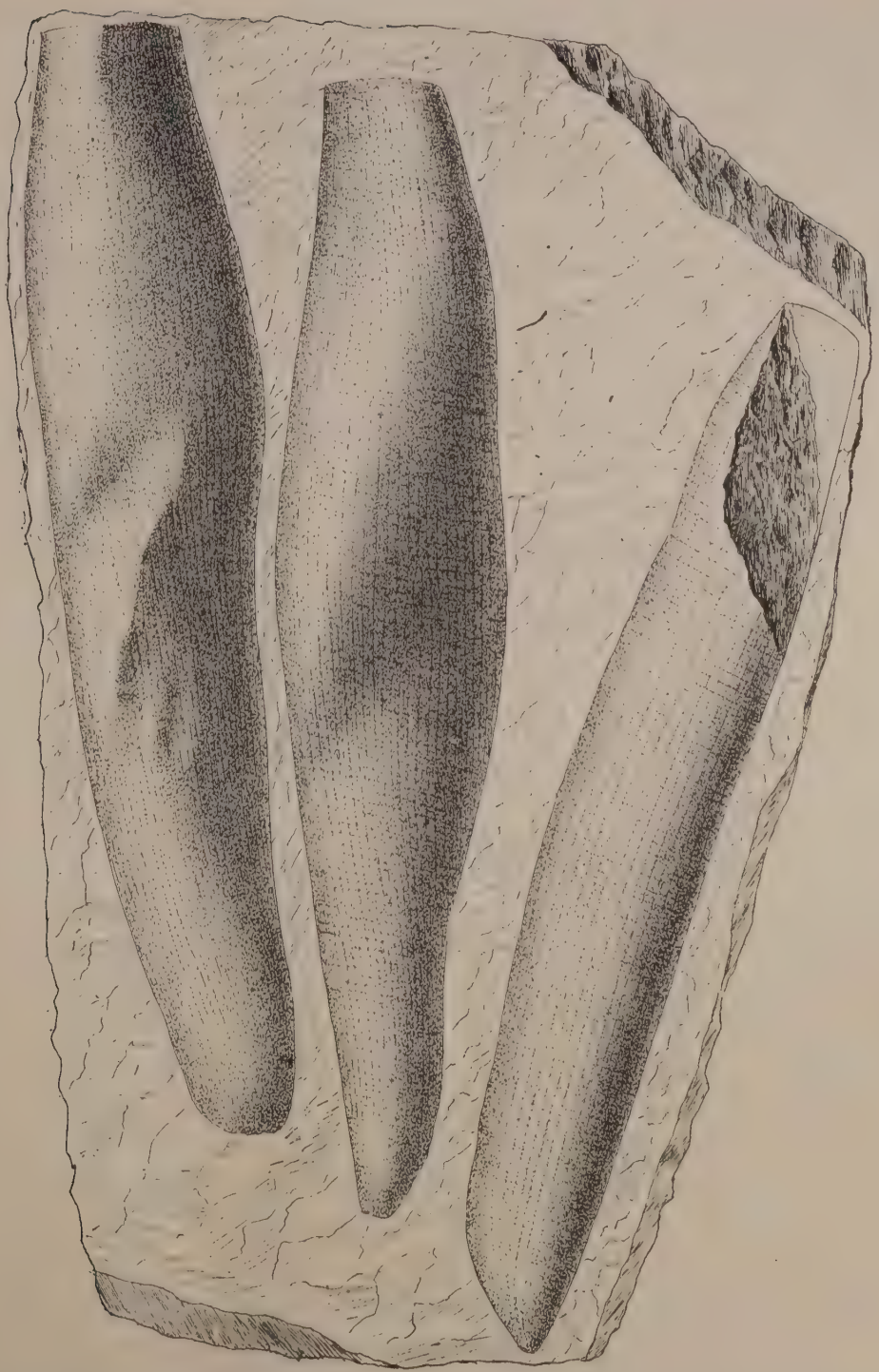


FIGURE 9. Three prostrate individuals of *Dictyospongia sceptrum*, which were rooted in a sandy sediment. Chemung sandstone, Cuba, N. Y.

Botryodictya ramosa in a soft sandy shale, near Mansfield, Tioga county, Pennsylvania, the only locality at which it has been observed.

Many of the sandstones of the Chemung series are rich in molluscan and other fossils, constituting a profuse and diverse assemblage of organic life, but the diffusion of this fauna is not uniform throughout the series. The fossils predominate in rather thin layers separated by intervals of barren sands. The sponges, however, do not usually occur in these highly fossiliferous bands. In the colonies at Bath and near Cohocton, the species of HYDNOCERAS have almost no other organic associates and their prolific growth seems to have crowded out other forms of life. Occasionally the cup of a *Taxocrinus* has been found among the sponges at the latter locality but no other organisms have been observed in the colonies at Bath. On the other hand, very near the base of the Chemung group, on Hamlin's farm in the township of Naples, and not over 150 feet above the last Portage fauna, is a colony of HYDNOCERAS where the specimens, not well preserved on account of the laminated condition of the sediments, are associated with these species: *Ambocœlia umbonata*, var. *gregaria*, *Cyrtina Hamiltonensis*, *Stropheodonta Cayuta*, *S. variabilis*, *S. arcuata*, *Leptostrophia perplana* var. *nervosa*, *Aviculopecten cancellatus*, *Sphenotus* sp., *Arthracantha* sp. Three miles away, at Deyo basin, in the same town, HYDNOCERAS occurs sparingly, with CERATODICTYA, HYDRIODICTYA, *Spirifer mesastrialis*, *Atrypa hystrix* and *Productella speciosa*.

In the upper part of the formation throughout the region in Allegany county which has proved so prolific in Dictyosponges, these species are frequently associated with *Spirifer disjunctus*, *Productella*, *Camarotœchia* and other brachiopods.

Such a habitat for these sponges as is indicated by the foregoing evidence is dissimilar to that of the recent hexactinellids. F. E. SCHULZE reports the number of species dredged by the Challenger Expedition, from the bottom of mud, clay or globigerina-ooze, as nearly twice that found on all other kinds of bottom. Of about one hundred species, five were trawled from sand and but two from gravel and stones. The EUPLECTELLIDÆ and other forms provided with a root tuft were mostly found on soft muddy ground. *Euplectella aspergillum* was taken in mud at a depth of 95 fathoms, while *E. crassistellata* was dredged in radiolarian-ooze at the immense depth of 2750 fathoms, the two species representing the extreme of depth at which the Hexactinellida were found.

These ancient allies and precursors of EUPLECTELLA seem to have been adapted to different conditions of growth. They flourished and attained their

highest development upon the sands and arenaceous muds of the upper Devonian, and among them are those most frequently provided with a root-tuft. The species of the Keokuk group grew on a soft muddy bottom like many of their modern representatives, accompanied by a profuse growth of crinoids and with many mollusca and brachiopoda; and while some of the species of the latter fauna are provided with root-tufts, the majority have broad bases indicating a sessile mode of growth on solid objects such as stones or dead shells.

HISTORICAL.

BIBLIOGRAPHY OF THE DICTYOSPONGIDÆ

1842.

1. T. A. CONRAD. *Observations on the Silurian and Devonian Systems of the United States, with descriptions of New Organic Remains.* (Proc. Acad. Nat. Sci. Philadelphia, vol. 8, pp. 267–8, pl. xvi, fig. 1.)

Describes the genus HYDNOCERAS and the species *H. tuberosum*, stated to be from the Chemung sandstones near Addison, Steuben county, N. Y. The author's account of this sponge was based on an internal cast which he conceived to represent an extravagant form of cephalopoda.

2. L. VANUXEM. *Geology of New York; Report on the Third District, pp. 182–3, fig. 50.*

A brief description is given, with a figure of an incomplete specimen of *Uphantænia* (*Hyphantænia*) *Chemungensis*, obtained from the Chemung sandstones "near the south end of the Ithaca and Oswego railroad." The author expresses his belief that the fossil was a marine plant. A figure of the original specimen will be found among the plates of this volume.

1852.

3. FREDERICK MCCOY. *A systematic Description of the British Palaeozoic Fossils in the Geological Museum of the University of Cambridge, p. 62, pl. 1. D, figs. 7, 8.*

Under the name *Tetragonis Danbyi*, the author describes a species of DICTYOSPONGIA from the upper Ludlow rocks of Westmoreland, evidently regarding the fossil a cystidean. It is placed among the *Echinodermata* in MORRIS'S *Catalogue of British Fossils*, p. 90, 1854, MURCHISON'S *Siluria*, third edition p. 536, 1859, and fourth edition, p. 509, 1872. In SALTER'S *Catalogue of the Cambrian and Silurian Fossils contained in the*

Geological Museum of the University of Cambridge, p. 176, 1873, the species is placed among the Sponges.

1862.

4. J. W. DAWSON. *On the Flora of the Devonian Period in Northeastern America.* (Quarterly Journal Geological Society, vol. xviii, p. 325, pl. xvii.)

Under the name *Uphantænia Chemungensis*, the author figures a specimen of *Hydnoceras tuberosum* from the Chemung group of New York and suggests that such forms were the cylindrical stems of the flabellate fronds described by VANUXEM under the former term. They are regarded "as *Algæ* with funnel-shaped fronds, sometimes prolonged into cylinders, and when adult, bearing fructification in tubercles on the sides of the cylinders."

1863.

5. JAMES HALL. *Observations upon the Genera Uphantænia and Dictyophyton, with notices of some Species from the Chemung group of New York and the Waverly sandstone of Ohio.* (Sixteenth Ann. Rep. N. Y. State Cab. Nat. Hist. pp. 84–91, pls. iii–v a.)

A description is given of *Uphantænia Chemungensis* with reprint from the original cut, but without additional specimens. The genus DICTYOPHYTON is introduced, based upon the species *D. Newberryi*, and, at the request of MR. CONRAD (as stated in a foot-note to page 87), it is allowed to replace the term HYDNOCERAS. The following species of DICTYOPHYTON are described:

D. Newberryi, nov.
D. filitextile, nov.
D. Redfieldi, nov.
D. Conradi, nov.
D. rude, nov.
D. fenestratum, nov.
D. annulatum, nov.
D. tuberosum, Conrad.
D. nodosum, nov.

All of these fossils are regarded as marine Algae.

1874.

6. E. P. LARKIN. *Dictyophyton.* (The Alfred Student, May, p. 53; A paper published under the auspices of Alfred University, at Alfred, Allegany county, N. Y.)

Describes a number of supposed variations of *D. tuberosum* and new species, viz.: *D. serratum, D. angulatum, D. lobatum, D. cylindricum, D. hastatum.* The descriptions are very incomplete and, in the absence of illustrations, the forms intended can not be recognized.

1879.

7. W. PH. SCHIMPER. *Zittel's Handbuch der Palaeontologie; Part II, Palaeophytolologie, Lief. 1, p. 69.*

The genera DICTYOPHYTON and UPHANTÆNIA are considered under a group of algae termed DICTYOPHYTEÆ. In regard to the genus DICTYOPHYTON, however, the author observed: "This regular lattice-work is so sharply defined and the elevated lines so uniformly straight that such impressions could be left in the rock only by bodies composed of very firm parts. Among living algae there are none which have such a composition. There are indeed very delicate algae which become hardened by calcareous incrustation, but such an ornamentation as this can not be the result of incrustation.

"The question arises whether we have not here the siliceous skeletons of sponges rather than highly abnormal forms of algae. We know how regularly the skeletons of the sponges are often constructed, and that a quadrate network is not infrequent among them. It is to be farther remarked that, as stated by HALL, no trace of coal on these remains has been observed."

Similar doubt is expressed as to the algous nature of UPHANTÆNIA.

1880.

8. FERDINAND ROEMER. *Lethæa Palæozoica, Erste Lieferung, pp. 127, 128, fig. 3, and p. 304, fig. 56.*

Describes the genera UPHANTÆNIA and DICTYOPHYTON, giving a figure of *Dictyophyton tuberosum* from Steuben county. Both are discussed among the fossil algae but are regarded as doubtfully of this nature. On pp. 303, 304, the genus TETRAGONIS and the species *T. Murchisonii*, Eichwald, *T. Danbyi*, McCoy and *T. Eifeliensis*, n. sp. are discussed, the last being illustrated by a fragment of the surface from the calcareous middle Devonian shales of Gerolstein. The genus is included in the family *Receptaculitidæ.*

1881.

9. R. P. WHITFIELD. *Observations on the Structure of Dictyophyton and its affinities with certain sponges.* (Amer. Journ. Science, vol. xxii, pp. 53, 54.)

Upon comparison of specimens of DICTYOPHYTON which had been described from the sandstones of the Chemung and Waverly groups, with the skeleton of EUPLECTELLA, the author concludes that these bodies are sponges, at

the same time setting forth the *a priori* evidence against their supposed vegetable nature.

10. R. P. WHITFIELD. *On the Nature of Dictyophyton.* (Amer. Journ. Science, vol. xxii, p. 132.)

Briefly refers to additional evidence of the spongous nature of these fossils, based upon a specimen from the Keokuk beds at Crawfordsville, Indiana, for which the name of *Uphantænia Dawsoni* is introduced. The specimen was referred to Dr. J. W. DAWSON for examination.

11. J. W. DAWSON. *Note on the Structure of a specimen of Uphantænia, from the Collection of the American Museum of Natural History, New York City.* (Amer. Journ. Science, vol. xxii, pp. 132, 133.)

This examination of a pyritized specimen from Crawfordsville, leads the author to conclude that it is probably a sponge

1882.

12. WARD'S *Natural Science Bulletin, vol 1, No. 1, p. 5.*

Gives a notice of the finding of the colony of *Dictyophyton* (*Hydnoceras*) *tuberosum*, Conrad, in the town of Cohocton, Steuben county, N. Y.

13 JAMES HALL. *Notes on the Family Dictyospongi[d]æ, plates 17–20, with explanations.* (Issued in advance of the Thirty-fifth Annual Report N. Y. State Museum of Natural History, 1884.)

The explanations accompanying these plates differ in some respects from those in the final form of the paper in the matter of generic identifications. The following species take date from this publication: *Dictyophyton* [*Ectenodictya*] *implexum*, *Clathrospongia abacus*, *Dictyophyton* [*Tylodictya*] *tenue*, *Phragmodictya* [*Aclæodictya*] *excentrica*, *P. scyphus* (=*P. catilliformis*, Whitfield), *Physospongia alternata*, *Phragmodictya* [*Thysanodictya*] *expansa*, *P. crebristriata*, *P. lineata.*

14. R. P. WHITFIELD. *Remarks on Dictyophyton and Descriptions of New Species of allied forms from the Keokuk beds of Crawfordsville, Indiana.* (Bull. No. I, Amer. Mus. Nat. Hist. pp. 10–20, pls. iii, iv.)

Reproduces the substance of observations made by the author and Princ. DAWSON (Nos. 9, 10, 11), redescribes *Uphantænia* [*Physospongia*] *Dawsoni* and gives the first descriptions of *Dictyophyton* [*Phragmodictya*] *catilliforme* and *D.* [*Dictyospongia*] *cylindricum*, all from the Keokuk group of Indiana.

15. K. A. VON ZITTEL. *Notizen über fossile Spongien (Protospongia, Dictyophyton, Corynella, Stellispongia, Verticillites).* (Neues Jahrb. für Mineral. vol. 2, pp. 203, 204.)

From the examination of a "Dictyophyton" [*tuberosum*, Conrad] sent to him by Professor WARD, of Rochester, the author confirms the opinion of WHITFIELD and HINDE, that the fossil belongs to the sponges and regards it as forming, with PROTOSPONGIA, a distinct family allied to EUPLECTELLA.

1883.

16. JAMES HALL. *On the Relations of Dictyophyton, Phragmodictyum and similar Forms with Uphantænia.* (Proc. Amer. Assoc. Adv. Sci., vol. 31 (for 1882), p. 419. Title only.)

17. CHARLES BARROIS. *Sur les Dictyospongidæ des Psammites du Condroz.* (Annales de la Soc. Geol. du Nord, vol. xi, pp. 80–86, pl. 1.)

The author records the occurrence of these sponges in the upper Devonian sandstones of Jeumont, Brittany, and identifies certain of them with the *Dictyophyton tuberosum*, Conrad [*Hydnoceras Barroisi*]. Another species is described as *D.* [*Dictyospongia*] *Morini*. It is suggested that these sponges belong to the suborder *Dictyonina*, Zittel.

18. GEORGE J. HINDE. *Catalogue of the Fossil Sponges in the Geological Department of the British Museum, pp. 130–132, pl. xxviii, fig. 3.*

The author places the genus DICTYOPHYTON among the Dictyonine sponges, under the family STAURODERMIDÆ, and in immediate association with PROTOSPONGIA, Salter. The view is expressed that the nine species of DICTYOPHYTON described by HALL (1863), probably all belong to the species *D. tuberosum*, Conrad, and that the *Tetragonis* [*Prismodictya*] *Eifeliensis*, F. Roemer, represents the same genus. A figure is given of a specimen from Cohocton, N. Y., probably the normal form of the species from the Brown hill colony. McCOY's species, *Tetragonis Danbyi*, is also described as *Dictyophyton Danbyi*, and it is observed that an examination of the original species of TETRAGONIS (*T. Murchisoni*, Eichwald) shows it to be closely allied to ISCHADITES.

19. FERDINAND ROEMER. *Notiz über die Gattung Dictyophyton.* (Zeitschr. der Deutsch. Geolog. Gesellsch., vol. xxxv, pp. 704–708, figs. a, b.)

Describes and figures a Dictyosponge from the middle Devonian of Gerolstein, under the name *Dictyophyton Gerolsteinense*. It is shown in the

following pages that this species represents a distinct type of generic structure and the name ROEMERISPONGIA is here introduced therefor. The author considers neither the algous nor the spongous nature of these fossils established.

1884.

20 JAMES HALL. *Descriptions of the Species of Fossil Reticulate Sponges, constituting the Family Dictyospongidæ.* (Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist. pp. 465–481, pls. 17 (18)–20 (21).)

This paper defines the new genera ECTENODICTYA, LYRODICTYA, THAMNODICTYA, PHRAGMODICTYA (1882), CLEODICTYA and PHYSOSPONGIA (1882), and gives brief descriptions of all the species known at that time. The following species take date from this publication: *Dictyophyton* [*Clathrospongia*] *Hamiltonense*, *D.* [*Hydriodictya*] *patulum*, *D.* [*Prismodictya*] *prismaticum*, *D.* [*P.*] *telum*, *D.* [*P.*] *baculum*, *D.* [*P.*] *parallelum*, *D.* [*Clathrospongia*] *irregulare*, *D.* [*Ceratodictya*] *cinctum*, *D.* [*Calathospongia?*] *sacculus*, *Ectenodictya* (*Lyrodictya?*) *Burlingtonensis*, *Lyrodictya Romingeri*, *Phragmodictya patelliformis*, *Cleodictya gloriosa*, *C. Mohri* *Physospongia Colletti.*

21. L. LESQUEREUX. *Description of the Coal Flora of the Carboniferous Formation in Pennsylvania and throughout the United States.* (Second Geol. Surv. Penn. Rept. P, vol. iii, p. 827.)

The author, regarding the fossils known as DICTYOPHYTON as marine algae, describes a new form under the name *Dictyophyton ramosum.* The species is considered at length in the following pages under the name, *Botryodictya ramosa.*

1886.

22. R. P. WHITFIELD. *Notice of a New Fossil Body, probably a Sponge related to Dictyophyton.* (Bull. No. 8, Amer. Mus. Nat. Hist. pp. 346–348, pl. xxxv, figs. 1–9.)

Under the generic name RHOMBODICTYON, are described two species from the Hudson River slates at Kenwood, near Albany, N. Y., of somewhat irregularly globose outline and having a surface marked by parallel raised lines crossed by flexuous oblique striae. The general aspect of these fossils suggests their spongous nature, but there is no satisfactory evidence of relationship to the Dictyosponges.

1887.

23. GEORGE J. HINDE. *A Monograph of the British Fossil Sponges, Part 1, pp. 1–92, pls. i–viii.*

The author erects the family PROTOSPONGIDÆ as a member of the order *Dictyonina*. It is made to include PROTOSPONGIA, Salter, PHORMOSELLA and PLECTODERMA, Hinde, "and possibly also some of the forms included under *Dictyophyton*, Hall" (p. 90). It is also observed that "by some authors the spicules are believed to be free from each other and thus of a Lyssacine character." On plate ii, are given figures (4, a–c) of *Dictyophyton* [*Dictyospongia*] *Danbyi*, McCoy (sp.), from the Ludlow beds of Westmoreland.

24. JAMES HALL. *Note on the Occurrence of the Dictyospongidæ in the State of New York.* (Sixth Ann. Rept. N. Y. State Geologist, pp. 36–38, map.)

Gives a table showing the distribution of the American species and a map exhibiting the geographical occurrence of specimens in western New York as known at that date.

1887.

25. F. E. SCHULZE. *Report on the Hexactinellida collected by H. M. S. Challenger during the years 1873–1876, p. 63.*

Reference is made to the determinations and suggestions by WHITFIELD and DAWSON as to the hexactinellid structure of some of the DICTYOSPONGIDÆ, and the announcement by WALCOTT of the spongous character of CYATHOPHYCUS. These forms are considered as "fossil EUPLECTELLIDÆ."

1888.

26. J. W. DAWSON. *New Species of Fossil Sponges from Little Métis, Province of Quebec, Canada.* (Canadian Record of Science, April, pp. 49–59.)

The substance of this paper is included and expanded in No. 30, with similar observations upon DICTYOPHYTON.

27. GEORGE J. HINDE. *Notes on Sponges from the Quebec group at Métis and from the Utica shale.* (Canadian Record of Science, April, pp. 59–68.)

The author remarks that both names CYATHOPHYCUS and DICTYOPHYTON, are unsuitable for sponges and that it might prove advisable to reinstate the name HYDNOCERAS, Conrad.

28 GEORGE J. HINDE. *A Monograph of the British Fossil Sponges, Part II, pp. 93–188, pl. ix.*

A description is given of the genus DICTYOPHYTON (p. 126), and of *D. Danbyi*, McCoy (sp.) (p. 128). It is observed "that the genus TETRAGONIS, Eichwald, is merely a synonym of ISCHADITES, Murch., and its characters markedly differ from those of DICTYOPHYTON."

1889.

29. CHARLES E. BEECHER. *Brachiospongidæ; a Memoir on a group of Silurian Sponges.* (Mem. Peabody Mus. Yale Univ. vol. 2, pt. 1, pp. 1–28, pls. i–vi.)

Under the family DICTYOSPONGIDÆ, Hall, are included (p. 16) the genera PROTOSPONGIA and CYATHOPHYCUS, together with HYDNOCERAS and its allies.

30. J. W. DAWSON. *New Species of Fossil Sponges from the Siluro-Cambrian at Little Métis, on the Lower St. Lawrence; with notes by Dr. G. J. Hinde.* (Trans. Roy. Soc. Canada, vol. VII, Sect. iv, pp. 31–55, pl. iii.)

In this work a number of remarkable forms of the PROTOSPONGIDÆ are described, together with other sponges whose structure is too imperfectly known to ensure their position among recognized families. A distinction is pointed out between the structure of CYATHOPHYCUS and the *Uphantænia* (*Physospongia*) *Dawsoni*, but that genus is ascribed to the DICTYOSPONGIDÆ, and referred to the sub-order *Dictyonina*. In a note upon page 39, Dr. HINDE suggests that there is good reason for regarding PROTOSPONGIA and allied palaeozoic genera as Lyssacine, rather than Dictyonine hexactinellids.

31. M. NEUMAYR. *Die Stämme des Thierreichs, p. 228.*

The author places DICTYOPHYTON among the Dictyonine hexactinellids but suggests that it may be Lyssacine.

32. E. O. ULRICH. *Preliminary Description of New Lower Silurian Sponges.* (American Geologist, vol. 3, p. 233.)

The species *Rauffella filosa*, Ulrich, of the Trenton group, which the author here suggests may be a Dictyosponge, has not the characters of this family.

1890.

33. JAMES HALL. *Fossil Dictyospongidæ of the Devonian and Carboniferous Formations: New Forms of Dictyospongidæ from the rocks of the Chemung group.* (Ninth Ann. Rept. N. Y. State Geol. pp. 56–60; Also published in Bull. Geol. Soc. America, vol. 1, p. 22; and in Forty-third Ann. Rept. N. Y. State Mus. pp. 258–262.)

In this paper two new genera are introduced: ACTINODICTYA and CRYPTODICTYA. The following species are described for the first time:

Dictyophyton sceptrum.
D. vascellum.
D. Randalli.
D. scitum.
D. Amalthea.
D. tomaculum.
D? (Phragmodictya) Halli.
Actinodictya placenta.
Cryptodictya Alleni.

1892.

34. CLEMENS SCHLÜTER. *Protospongia rhenana.* (Zeitsch. der Deutsch. Geolog. Gesellsch., pp. 615–618, figure.)

Under the above name is described a species from the lower Devonian Hunsrück slates, near Gemünden, which is represented by a large, quite incomplete specimen, showing quadrate reticulations in a diminishing series. The quadrules appear to be formed by bundles of spicular filaments associated with stauractins. The species is undoubtedly a Dictyosponge but its generic relations are uncertain.

1893.

35. N. H. WINCHELL and C. SCHUCHERT. *Sponges, Graptolites and Corals from the Lower Silurian of Minnesota.* (Extract from vol. iii, Final Report of the Minnesota Geol. Surv. p. 75, pl. F, figs. 16–20.)

Rauffella filosa, Ulrich, is redescribed and placed under the family DICTYSPONGIDÆ. It is asserted by RAUFF that this is not an organism.

36. HERMANN RAUFF. *Palaeospongiologie, Part I, Lieferungen 1–4, pp. 1–232.* (Palaeontographica, vol. xl.)

In this comprehensive undertaking, which plans an exhaustive treatise of all fossil sponges, the author opens with an elaborate bibliography of the subject, embracing 591 references up to the year 1892, following this with an analysis of the work of those writers whose investigations have been of especial influence in the study of these organisms. A long chapter on the

morphology of the sponges, both of their soft and skeletal parts, with abundant illustration, is constructed with especial reference to the fossil forms. In the systematic treatment of these bodies the suborder *Lyssacina* is made to include eight families, as follows: PROTOSPONGIDÆ, Hinde, DICTYOSPONGIDÆ, Hall, PLECTOSPONGIDÆ, Rauff, EUPLECTELLIDÆ, Gray, ASCONEMATIDÆ, Schulze, ROSSELLIDÆ, Schulze, HYALONEMATIDÆ, Schulze, BRACHIOSPONGIDÆ, Beecher.

The author is the first to establish distinctive characters between the PROTOSPONGIDÆ and the DICTYOSPONGIDÆ and to suggest the probability that CYATHOPHYCUS, PLECTODERMA and PHORMOSELLA are not safely placed with either of these families; hence the erection of the family PLECTOSPONGIDÆ. The final chapter in this portion of the work relates to the mode of preservation of the fossil sponges.

1894.

37. HERMANN RAUFF. *Palaeospongiologie, Part 1, Lieferungen 5, 6, pp. 233–346, pls. i–xvii.* (Palaeontographica, vol. xl.)

This instalment of the same work is devoted to descriptions of palaeozoic species. The various forms of the PROTOSPONGIDÆ described by DAWSON, and the PLECTOSPONGIDÆ (CYATHOPHYCUS, TEGANIUM), are described and in many instances illustrated with new figures. On page 249, under the family DICTYOSPONGIDÆ, is described as *Dictyophytra (?) Walcotti*, Rauff, a new species from the Utica slate at Holland Patent, N. Y. DICTYOPHYTRA is evidently a proposed modification of the term DICTYOPHYTON; as a substitute for the latter it is unobjectionable etymologically and in its application to these fossils, but it is objectionable historically if used in the broad sense in which the term DICTYOPHYTON has heretofore been applied. The definition of the genus is deferred to a later part of the work and its value, therefore, can not be determined until the author makes known upon what forms of "*Dictyophyton*" the genus is based.

Dictyophytra (?) Walcotti, (pl. iv, figs. 1, 2) is founded upon the fragment of a large, coarse-meshed species, quite distinct in size and texture from its associate, *Cyathophycus reticulatus*. That it is a true Dictyosponge, however, and not a CYATHOPHYCUS, can not be regarded as established.

The 7th and 8th Lieferungen of this work, dated 1895, contain nothing especially relating to the Hexactinellida.

We greatly regret that Dr. RAUFF's observations upon the Devonian and Carboniferous Dictyosponges have not been received as this volume goes to press.

38 JOHN M. CLARKE. *New or Rare Species of Fossils from the horizons of the Livonia Salt Shaft.* (Thirteenth Ann. Rept. N. Y. State Geologist, vol. 1, p. 177, pl. IV, figs. 19–22. Also in Forty-seventh Annual Report N. Y. State Museum, p. 371.)

Describes as *Hyalostelia? Marcellia*, a species from the bituminous shales of the Marcellus epoch, the generic characters of which are quite obscure, though the presence of broad unresolvable spicules of great size and having the form of blades of grass, indicates a structure unlike any heretofore described. The original form of the species is unknown.

1895.

39. K. A. v. ZITTEL. *Grundzüge der Palaeontologie, pp. 52 et seq.*

The author here recognizing the two suborders of the HEXACTINELLIDA, *Lyssacina* and *Dictyonina*, places under the former the three families, PROTOSPONGIDÆ, DICTYOSPONGIDÆ and PLECTOSPONGIDÆ. The definition of each of these families is essentially that given by RAUFF.

1896.

40. K. A. VON ZITTEL. *Text-book of Palaeontology; Translated and edited by Charles R. Eastman, pp. 54 et seq.*

The subject is here treated as in No. 39, of which this is a translation and enlargement.

41. GEORGE H. GIRTY. *A Revision of the Sponges and Coelenterates of the Lower Helderberg Fauna of New York.* (Fourteenth Ann. Rept. N. Y. State Geologist, pp. 258 *et seq.* Also Forty-eighth Annual Report N. Y. State Museum, p. 261.)

For certain hexactinellid spicules from the Lower Helderberg rocks the author introduces the generic term LYSACTINELLA and makes use of two specific names, one applied to smooth spicules, the other to those having thorny rays.

1897.

42. FERDINAND ROEMER and FRITZ FRECH. *Lethaea Geognostica, 1 Theil; Lethaea Palaeozoica, 1 Band*

This is a continuation of ROEMER'S work, the plates of which appeared in 1876 and the first instalment of the text in 1880. So far as the Dictyosponges are concerned no additions or changes are made from the treatment of the genera as cited under No. 8.

CLASSIFICATION OF THE DICTYOSPONGIDÆ.

The manifold variations in form expressed by these sponges are accompanied by certain structural diversities which, however, do not lead far a-field from the comprehensive definition elsewhere given of the indicial characters of the Family. It has been, in our judgment, wise not to endow any of these structural characters with so high value as to necessitate the erection of additional Family terms, and experience indicates that few thin-walled siliceous sponges of the Devonian and Carboniferous faunas will fail to find a place within the limits of this Family, DICTYOSPONGIDÆ. The structural variations of chief importance are herewith summarized and utilized as the basis of a subordinate classification.

Subfamily I.

DICTYOSPONGIINÆ.

Simple, vase-shaped or elongate, smooth, prismatic, nodose or annulated forms with obconical base; with basal prostalia; with or without marginalia; no basal disk; primitive form a regular obcone.

Dictyospongia,	Helicodictya,
(?) Lysactinella,	Rhabdosispongia,
Hydriodictya,	Ceratodictya,
Prismodictya,	Clathrospongia,
Gongylospongia,	Lebedictya,
Hydnoceras,	Lyrodictya,
(?) Tylodictya,	(?) Mastodictya.

BOTRYODICTYA, which appertains to this group in its principal characters, is aberrant in the possession of a more or less complete diaphragm, not at the base but near the middle of the sponge, just below the nodiferous body.

Subfamily II.

THYSANODICTYINÆ.

Cylindrical or expanding cups, with basal disk and periloph.

Thysanodictya,	Phragmodictya,
Arystidictya,	(?) Griphodictya.

Subfamily III.

CALATHOSPONGIINÆ.

Expanding forms with smooth, tufted or nodose surface and obtuse basal extremity without diaphragm or periloph.

Calathospongia,	Clepsydrospongia,
Thamnodictya,	Cleodictya.

The genus CLEPSYDROSPONGIA presents, in its tufted nodose surface, the aspect of HYDNOCERAS, but is as broad at the basal, as at the apertural extremity.

CLEODICTYA is tentatively placed in this division on account of its apparently broad base.

Subfamily IV.

PHYSOSPONGIINÆ.

Stout cups with a single or double series of strong horizontal and vertical spicular bundles, tufted at their intersections; meshes covered by thin bullate expansions or depressions of the reticulum (parenchymalia); no basal disk (?).

Physospongia,	Roemerispongia.

Subfamily V.

HYPHANTÆNIINÆ.

Large saucer-shaped fronds composed of a single series of ligulate concentric and radial reticulating bands; meshes partially closed by parenchymal reticulum; attached by basal apex (basalia?).

Hyphantænia.

Subfamily VI.

HALLODICTYINÆ.

Irregularly growing, explanate or frondiform sponges, with smooth or tufted nodate surface.

Hallodictya,	Cryptodictya.
Actinodictya,	

Subfamily VII.

AGLITHODICTYINÆ.

Discoid sponges, rapidly expanding and contracting; attached by apex (basalia?); osculum large.

Aglithodictya.

Synoptic List of Genera and Species of the Dictyospongidæ.

Subkingdom

SPONGIÆ.

Class

SILICEA, Gray.

Order

HEXACTINELLIDA, O. Schmidt.

Suborder

LYSSACINA, Zittel.

Family

DICTYOSPONGIDÆ, Hall.

Subfamily **DICTYOSPONGIINÆ**, subfam. nov.

Genus **Dictyospongia**, gen. nov.

D. Danbyi, McCoy (sp.).
D.? Marcellia, Clarke (sp.).
D. haplea, sp. nov.
D. sceptrum, Hall (sp.).
D. lophura, sp. nov.
D. charita, sp. nov.
D. eumorpha, sp. nov.
D. siræa, sp. nov.
D. Almondensis, sp. nov.
D. bacteria, sp. nov.
D. Morini, Barrois (sp.).
D. cylindrica, Whitfield (sp.).
D. stylina, sp. nov.

Genus **Lysactinella**, Girty.

L. Gebhardi, Girty.
L. perelegans, Girty.

Genus **Hydriodictya**, gen. nov.

H. patula, Hall (sp.).
H. cylix, sp. nov.
H. nephelia, sp. nov.

Genus **Prismodictya**, gen. nov.

P. palæa, sp. nov.
P. telum, Hall (sp.).
P. banano, sp. nov.
P. amicitiæ, sp. nov.

P. baculum, Hall (sp.).
P. spectabilis, sp. nov.
P. parallela, Hall (sp.).
P. prismatica, Hall (sp.).
P. Allegania, sp. nov.
P. choanea, sp. nov.
P. corynia, sp. nov.
P. filitextilis, Hall (sp.).
P. aulophia, sp. nov.
P. ptionia, sp. nov.
P. cercidea, sp. nov.
P. cithara, sp. nov.
P. narthecia, sp. nov.
P. Conradi, Hall (sp.).
P. polyhedra, sp. nov.

Genus **Gongylospongia**, gen. nov.

G. Marshi, sp. nov.

Genus **Hydnoceras**, Conrad.

H. legatum, sp. nov.
H. gracile, sp. nov.
H. tuberosum, Conrad.
H. tuberosum,
var. glossema, var. nov.
H. Bathense, sp. nov.
H. botrœdema, sp. nov.
H. Avoca, sp. nov.
H. phymatodes, sp. nov.
H. hypastrum, sp. nov.
H. eutheles, sp. nov.
H. multinodosum, sp. nov.
H. Lutheri, sp. nov.
H. rhopalum, sp. nov.
H. variabile, sp. nov.
H. nodosum, Hall (sp.).
H. anthracis, sp. nov.
H. eumeces, sp. nov.
H. Barroisi, nom. nov.
H. Jeumontense, sp. nov.

Genus **Botryodictya**, gen. nov.

B. ramosa, Lesquereux (sp.).
B. (or Tylodictya) sp. nov.

Genus **Tylodictya**, gen. nov.

T. Warrenensis, sp. nov.
T.? tenuis, Hall (sp.).

Genus **Helicodictya**, gen. nov.

H. trypania, sp. nov.
H.? Concordia, sp. nov.
H.? Scio, sp. nov.

Genus **Rhabdosispongia**, gen. nov.

R. Amalthea, Hall (sp.).
R. Condroziana, sp. nov.

Genus **Ceratodictya**, gen. nov.

C. Carpenteriana, sp. nov.
C. cincta, Hall (sp.).
C. zonata, sp. nov.
C. annulata, Hall (sp.).
C. centeta, sp. nov.

Genus **Clathrospongia**, Hall.

C.? Hamiltonensis, Hall (sp.).
C. fenestrata, Hall.
C. vascellum, Hall.
C.? tomaculum, Hall.
C. irregularis, Hall.
C.? desmia, sp. nov.
C. abacus, Hall.
C. caprodonta, sp. nov.

Genus **Lebedictya**, gen. nov.

L. crinita, sp. nov.

Genus **Lyrodictya**, Hall.

L. Romingeri, Hall.
L.? Burlingtonensis, Hall (sp.).

Genus **Mastodictya**, gen. nov.

M. osculata, sp. nov.

SUBFAMILY **THYSANODICTYINÆ**, subfam. nov.

Genus **Thysanodictya**, gen. nov.

T. Edwin-Halli, Hall (sp.).
T. pœcilus, sp. nov.
T. rudis, Hall (sp.).
T. Randalli, Hall (sp.).
T. saccus, sp. nov.
T. Johnstoni, sp. nov.
T. quasillum, sp. nov.
T. scyphina, sp. nov.
T. hermenia, sp. nov.
T. apleta, sp. nov.
T. turricula, sp. nov.
T. expansa, Hall (sp.).

Genus **Phragmodictya**, Hall.

P. catilliformis, Whitfield (sp.).
P.? crebristriata, Hall.
P.? lineata, Hall.

Genus **Arystidictya**, gen. nov.

A. elegans, sp. nov.
A. nodifera, sp. nov.

Genus **Aclœodictya**, gen. nov.

A. marsipus, sp. nov.
A.? excentrica, Hall (sp.).

Genus **Griphodictya**, gen. nov.

G. epiphanes, sp. nov.

SUBFAMILY **CALATHOSPONGIINÆ**, subfam. nov.

Genus **Calathospongia**, gen. nov.

C. Redfieldi, Hall (sp.).
C. carceralis, sp. nov.
C. Carlli, sp. nov.
C. Tiffanyi, sp. nov.
C.? sacculus, Hall (sp.).
C. amphorina, sp. nov.
C.? magnifica, sp. nov.

Genus **Thamnodictya**, Hall.

T. Newberryi, Hall. T. Ortoni, sp. nov.

Genus **Clepsydrospongia**, gen. nov.

C. matutina, sp. nov.

Genus **Cleodictya**, Hall.

C. Claypolei, sp. nov. C. Mohri, Hall.
C. gloriosa, Hall.

SUBFAMILY **PHYSOSPONGIINÆ**, subfam. nov.

Genus **Physospongia**, Hall.

P. Dawsoni, Whitfield (sp.). P. alternata, Hall.
P. Colletti, Hall. P. multibursaria, sp. nov.

Genus **Roemerispongia**, gen. nov.

R. Gerolsteinensis, F. Roemer (sp.).

SUBFAMILY **HYPHANTÆNIINÆ**, subfam. nov.

Genus **Hyphantænia**, Vanuxem.

H. Chemungensis, Vanuxem.

SUBFAMILY **HALLODICTYINÆ**, subfam. nov.

Genus **Hallodictya**, gen. nov.

H. Sciensis, sp. nov. H. Cottoniana, sp. nov.

Genus **Actinodictya**, Hall.

A. placenta, Hall.

Genus **Cryptodictya**, Hall.

C. Alleni, Hall.

SUBFAMILY **AGLITHODICTYINÆ**, subfam. nov.

Genus **Aglithodictya**, gen. nov.

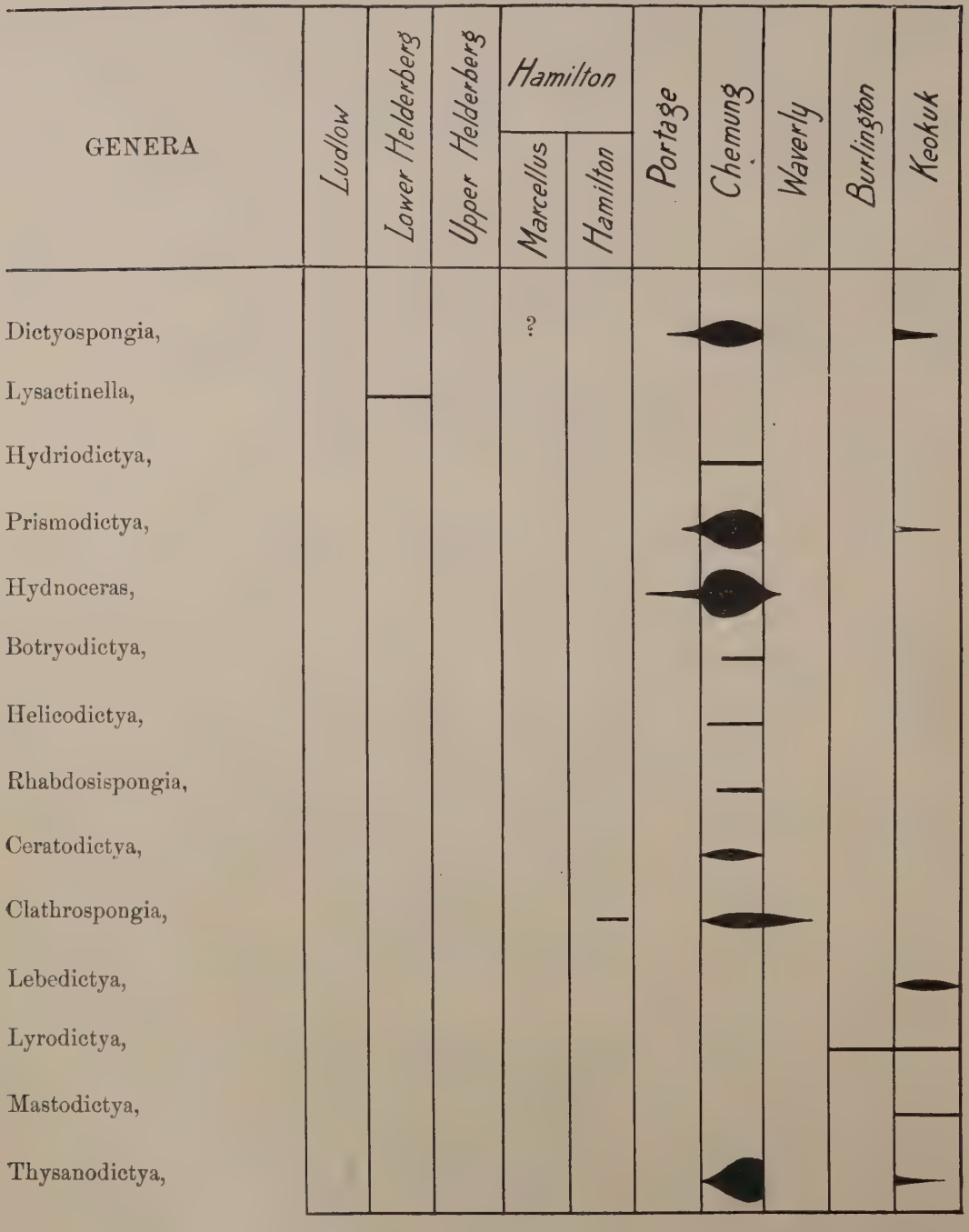
A. numulina, sp. nov.

Dubitandæ sedis.

? Genus **Ectenodictya**, Hall.

?E. implexa, Hall.

Generic Distribution of the Dictyospongidæ.



Generic Distribution of the DICTYOSPONGIDÆ (*Concluded*).

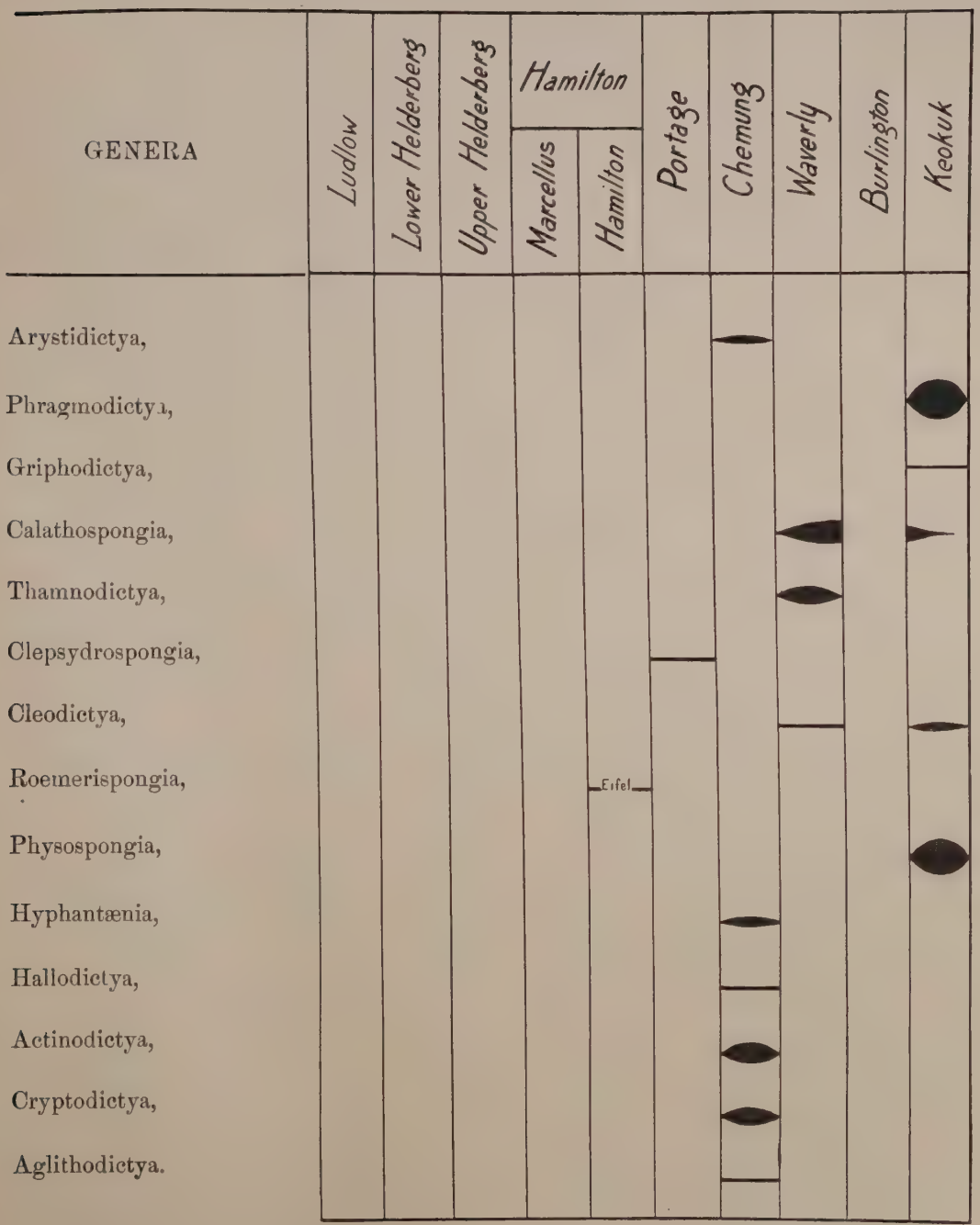


Table Showing the Geological Distribution of the Dictyospongidæ.

	NAME OF SPECIES.	Ludlow beds, England.	Lower Helderberg group.	Upper Helderberg group	Hamilton Group.		Portage group.	Chemung group.	Waverly group.	Burlington limestone.	Keokuk group.
					Marcellus shales.	Hamilton shales.					
		1	2	3	4	5	6	7	8	9	10
1	Dictyospongia Danbyi, McCoy (sp.)	x	..	..	..	..	..	..	..	..	..
2	D.? Marcellia, Clarke (sp.)	..	..	..	x	..	..	..	..	..	..
3	D. haplea, sp. nov	..	..	..	..	..	x	..	..	..	..
4	D. sceptrum, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
5	D. lophura, sp. nov	..	..	..	..	..	..	x	..	..	..
6	D. charita, sp. nov	..	..	..	..	..	..	x	..	..	..
7	D. eumorpha, sp. nov	..	..	..	..	..	..	x	..	..	..
8	D. siræa, sp. nov	..	..	..	..	..	..	x	..	..	..
9	D. Almondensis, sp. nov	..	..	..	..	..	..	x	..	..	..
10	D.? bacteria, sp. nov	..	..	..	..	..	..	x	..	..	..
11	D. stylina, sp. nov	..	..	..	..	..	..	..	..	..	x
12	D. cylindrica, Whitfield (sp.)	..	..	..	..	..	..	..	..	..	x
13	D. Morini, Barrois (sp.)	..	..	..	..	..	..	x*	..	..	..
14	Lysactinella Gebhardi, Girty	..	x	..	..	..	..	..	..	..	..
15	L. perelegans, Girty	..	x	..	..	..	..	..	..	..	..
16	Hydriodictya patula, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
17	H. cylix, sp. nov	..	..	..	..	..	..	x	..	..	..
18	H. nephelia, sp. nov	..	..	..	..	..	..	x	..	..	..
19	Prismodictya palæa, sp. nov	..	..	..	..	..	x	..	..	..	..
20	P. telum, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
21	P. baculum, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
22	P. spectabilis, sp. nov	..	..	..	..	..	..	x	..	..	..
23	P. parallela, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
24	P. prismatica, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
25	P. Allegania, sp. nov	..	..	..	..	..	..	x	..	..	..
26	P. choanea, sp. nov	..	..	..	..	..	..	x	..	..	..
27	P. corynia, sp. nov	..	..	..	..	..	..	x	..	..	..
28	P. filitextilis, Hall	..	..	..	..	..	..	x	..	..	..
29	P. banano, sp. nov	..	..	..	..	..	..	x	..	..	..
30	P. amicitiæ, sp. nov	..	..	..	..	..	..	x	..	..	..
31	P. aulophia, sp. nov	..	..	..	..	..	..	x	..	..	..
32	P. ptionia, sp. nov	..	..	..	..	..	..	x	..	..	..
33	P. cercidea, sp. nov	..	..	..	..	..	..	x	..	..	..
34	P. cithara, sp. nov	..	..	..	..	..	..	x	..	..	..
35	P. narthecia, sp. nov	..	..	..	..	..	..	x	..	..	..
36	P. Conradi, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
37	P. polyhedra, sp. nov	..	..	..	..	..	..	..	..	..	x
38	Gongylospongia Marshi, sp. nov	..	..	..	..	..	..	x	..	..	..
39	Hydnoceras legatum, sp. nov	..	..	..	..	..	x	..	..	..	..
40	H. gracile, sp. nov	..	..	..	..	..	x	..	..	..	..

* From the Psammites du Condroz, France.

Table Showing the Geological Distribution of the DICTYOSPONGIDÆ *(Cont'd)*.

		1	2	3	4	5	6	7	8	9	10
41	H. tuberosum, Conrad	..	..	..	..	..	..	x	..	..	..
42	H. tuberosum, var. glossema, var. nov	..	..	..	..	..	..	x	..	..	..
43	H. Bathense, sp. nov	..	..	..	..	..	..	x	..	..	..
44	H. botrœdema, sp. nov	..	..	..	..	..	..	x	..	..	..
45	H. Avoca, sp. nov	..	..	..	..	..	..	x	..	..	..
46	H. phymatodes, sp. nov	..	..	..	..	..	..	x	..	..	..
47	H. hypastrum, sp. nov	..	..	..	..	..	..	x	..	..	..
48	H. eutheles, sp. nov	..	..	..	..	..	x	x	..	..	..
49	H. multinodosum, sp. nov	..	..	..	..	..		x	..	..	..
50	H. Lutheri, sp. nov	..	..	..	..	..	..	x	..	..	..
51	H. rhopalum, sp. nov	..	..	..	..	..	..	x	..	..	..
52	H. variabile, sp. nov	..	..	..	..	..	..	x	..	..	..
53	H. nodosum, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
54	H. anthracis, sp. nov	..	..	..	..	..	..	x	..	..	..
55	H. eumeces, sp. nov	..	..	..	..	..	..	x	..	..	..
56	H. Barroisi, nom. nov	..	..	..	..	..	..	x*	..	..	..
57	H. Jeumontense, sp. nov	..	..	..	..	..	..	x*	..	..	..
58	Botryodictya ramosa, Lesquereux (sp.)	..	..	..	..	..	..	x	..	..	..
59	B. (or Tylodictya) sp. nov	..	..	..	..	..	..	x	..	..	..
60	Tylodictya Warrenensis, sp. nov	..	..	..	..	..	..	..	x	..	..
61	T.? tenuis, Hall (sp.)	..	..	..	..	..	..	..	x	..	..
62	Helicodictya trypania, sp. nov	..	..	..	..	..	..	x	..	..	..
63	H.? Concordia, sp. nov	..	..	..	..	..	..	x	..	..	..
64	H.? Scio, sp. nov	..	..	..	..	..	..	x	..	..	..
65	Rhabdosispongia Amalthea, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
66	R. Condroziana, sp. nov	..	..	..	..	..	..	x*	..	..	..
67	Ceratodictya Carpenteriana, sp nov	..	..	..	..	..	..	x	..	..	..
68	C. cincta, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
69	C. zonata, sp. nov	..	..	..	..	..	..	x	..	..	..
70	C. annulata, Hall (sp.)	..	..	..	..	..	..	x	..	..	..
71	C. centeta, sp. nov	..	..	..	..	..	..	x	..	..	..
72	Clathrospongia (?) Hamiltonensis, Hall (sp.)	..	..	..	..	x	..	..	..	..	..
73	C. fenestrata, Hall	..	..	..	..	..	..	x	..	..	..
74	C. vascellum, Hall	..	..	..	..	..	..	x	..	..	..
75	C.? tomaculum, Hall	..	..	..	..	..	..	x	..	..	..
76	C. irregularis, Hall	..	..	..	..	..	..	x	..	..	..
77	C.? desmia, sp. nov	..	..	..	..	..	..	x	..	..	..
78	C. abacus, Hall	..	..	..	..	..	..	..	x	..	..
79	C. caprodonta, sp. nov	..	..	..	..	..	..	..	x	..	..
80	Lebedictya crinita, sp. nov	..	..	..	..	..	..	..	..	..	x
81	Lyrodictya Romingeri, Hall	..	..	..	..	..	..	..	..	..	x
82	L.? Burlingtonensis, Hall (sp.)	..	..	..	..	..	..	..	..	x	..
83	Mastodictya osculata, sp. nov	..	..	..	..	..	..	..	..	..	x
84	Thysanodictya Edwin-Halli, Hall (sp)	..	..	..	..	..	..	x	..	..	..
85	T. pœcilus, sp. nov	..	..	..	..	..	..	x	..	..	..
86	T. rudis, Hall (sp)	..	..	..	..	..	..	x	..	..	..
87	T. Randalli, Hall (sp.)	..	..	..	..	..	..	x	..	..	..

* From the Psammites du Condroz, France.

Table Showing the Geological Distribution of the DICTYOSPONGIDÆ (*Concl'd*).

		1	2	3	4	5	6	7	8	9	10
88	T. saccus, sp. nov.	..	..	..	..	..	..	x	..	..	..
89	T. Johnstoni, sp. nov	..	..	..	..	..	..	x	..	..	..
90	T. quasillum, sp. nov	..	..	..	..	..	..	x	..	..	..
91	T. scyphina, sp. nov.	..	..	..	..	..	..	x	..	..	..
92	T. hermenia, sp. nov.	..	..	..	..	..	..	x	..	..	..
93	T. apleta, sp. nov	..	..	..	..	..	..	x	..	..	..
94	T. turricula, sp. nov	..	..	..	..	..	..	x	..	..	..
95	T. expansa, Hall (sp.)	..	..	..	..	..	..	..	x	..	..
96	Phragmodictya catilliformis, Whitfield (sp.)	..	..	..	..	..	..	..	..	..	x
97	P.? crebristriata, Hall	..	..	..	..	..	..	..	..	..	x
98	P.? lineata, Hall	..	..	..	..	..	..	..	..	..	x
99	Aclœodictya marsipus, sp. nov.	..	..	..	..	..	..	..	..	..	x
100	A.? excentrica, Hall (sp.)	..	..	..	..	..	..	..	..	..	x
101	Arystidictya elegans, sp. nov	..	..	..	..	..	..	x	..	..	..
102	A. nodifera, sp. nov	..	..	..	..	..	..	x	..	..	..
103	Griphodictya epiphanes, sp. nov.	..	..	..	..	..	..	..	..	..	x
104	Calathospongia Redfieldi, Hall (sp.)	..	..	..	..	..	..	..	x	..	..
105	C. carceralis, sp. nov	..	..	..	..	..	..	..	x	..	..
106	C. Carlli, sp. nov	..	..	..	..	..	..	..	x	..	..
107	C. Tiffanyi, sp. nov	..	..	..	..	..	..	..	x	..	..
108	C.? sacculus, Hall (sp.)	..	..	..	..	..	..	..	x	..	..
109	C. amphorina, sp. nov.	..	..	..	..	..	..	..	..	..	x
110	C.? magnifica, sp. nov	..	..	..	..	..	..	..	..	..	x
111	Thamnodictya Newberryi, Hall.	..	..	..	..	..	..	..	x	..	..
112	T. Ortoni, sp. nov	..	..	..	..	..	..	..	x	..	..
113	Clepsydrospongia matutina, sp. nov.	..	..	..	..	..	x	..	..	..	..
114	Cleodictya Claypolei, sp. nov.	..	..	..	..	..	..	..	x	..	..
115	C. gloriosa, Hall	..	..	..	..	..	..	..	..	..	x
116	C. Mohri, Hall	..	..	..	..	..	..	..	..	..	x
117	Roemerispongia Gerolsteinensis, Roemer (sp.)	..	..	..	..	x*	..	..	..	..	..
118	Physospongia Dawsoni, Whitfield (sp.)	..	..	..	..	..	..	..	..	..	x
119	P. Colletti, Hall	..	..	..	..	..	..	..	..	..	x
120	P. alternata, Hall	..	..	..	..	..	..	..	..	..	x
121	P. multibursaria, sp. nov	..	..	..	..	..	..	..	..	..	x
122	Hyphantænia Chemungensis, Vanuxem	..	..	..	..	..	..	x	..	..	..
123	Hallodictya Sciensis, sp. nov	..	..	..	..	..	..	x	..	..	..
124	H. Cottoniana, sp. nov	..	..	..	..	..	..	x	..	..	..
125	Actinodictya placenta, Hall	..	..	..	..	..	..	x	..	..	..
126	Cryptodictya Alleni, Hall	..	..	..	..	..	..	x	..	..	..
127	Aglithodictya numulina, sp. nov.	..	..	..	..	..	..	x	..	..	..
128	Ectenodictya implexa, Hall	..	..	..	..	..	..	..	x	..	..

* From the middle Devonian of Gerolstein in the Eifel.

DESCRIPTIONS

OF GENERA AND SPECIES.

Of the considerable number of genera here discussed, several are represented by many species whose differentials may seem obscure or, to some students, overestimated. In fixing specific values within a given genus of such variable organisms, it has been found necessary to depend very largely upon variations in form as the paramount specific character. If, in this practise, what may seem, in such prolific genera as PRISMODICTYA, HYDNOCERAS and THYSANODICTYA, to be traits of lesser value, are dignified with specific distinction, it is because such distinctions are, in the existing state of our knowledge, the truest expression of these relations, as well as the most convenient denomination. To future investigations with the aid of more extensive material, must be assigned the determination of fundamental type forms, in terms of which all of these manifold variations may be expressed.

SPECIES OF THE SILURIAN.

DICTYOSPONGIA, gen. nov.

(For description see page 812.)

DICTYOSPONGIA DANBYI, McCoy (sp.).

1855. *Tetragonis Danbyi*, McCoy. British Palaeozoic Fossils, p. 62, pl. 1 D, figs. 7, 8.

1880. *Tetragonis Danbyi*, F. Roemer. Lethæa Palæozoica, Part 1, p. 304.

1883. *Dictyophyton Danbyi*, Hinde. Cat. Fossil Sponges British Museum, p. 131.

1887. *Dictyophyton Danbyi*, Hinde. Monogr. British Fossil Sponges, Part 1, pl. ii, figs. 4 a–c.

1888. *Dictyophyton Danbyi*, Hinde. Monogr. British Fossil Sponges, Part 2, p. 128.

"Sponges subovate or sub-conical in form, growing from an obtuse basal point, without stem, root or point of attachment; the base is flattened or convex, the greatest width in some specimens is just above the base, in others about half the height of the sponge, from this it gradually tapers to the

summit which appears to have been open. The specimens vary between 23 and 30 mm. in height, and from 14 to 17 mm. in width.

"The sponge-wall appears to have been smooth and even; the larger areas of the rectangular mesh-work are marked out by more prominent, vertical and transverse raised lines, and vary from 1.5 to 3 mm. in length, and these are subdivided by finer lines into smaller squares, the sides of which are about .75 mm. in length. In some cases the stronger lines forming the larger squares are nearly parallel from the base to the summit, whilst in others they converge to each other towards the base.

"No spicular structure whatever has been preserved in any of the specimens yet discovered, which are merely casts in a matrix of micaceous sandstone. No structure can be detected in the interior of the specimens." (HINDE, *op. cit.* 1888.)

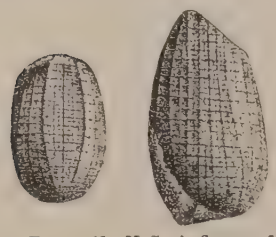


FIGURE 10. McCOY'S figures of *Tetragonis Danbyi.*

The foregoing description was based upon McCOY'S original specimens and his figures are here reproduced. These show an obscurely prismatic form which is not reproduced in the figures of the species given by HINDE nor mentioned in his description. This species, a fossil of rare occurrence, is the oldest known representative of the DICTYOSPONGIDÆ.

Localities. From the upper Ludlow rocks at Brigsteer, Benson, Underbarrow and Kendal, Westmoreland, England.

SPECIES OF THE DEVONIAN

SPECIES OF THE LOWER HELDERBERG GROUP.

LYSACTINELLA, Girty.

1896. *Lysactinella*, Girty. Fourteenth Ann. Report N. Y. State Geologist, pp. 258–261, pl. 1.

This genus has been recently described from free spicules obtained by etching the silica-bearing limestones of the Lower Helderberg group in Albany county, N. Y. Very little is yet known of the form of the sponge body in either of the two species established. Mr. GIRTY speaks of one species, *L. Gebhardi*, as being flattened spherical, but of this as probably a quite accidental shape due to compression and distortion. The spicules of this species, so far as isolated, are smooth forms, mostly hexactine and pentactine. *Lysactinella perelegans* is based on a series of spicules with echinate

arms. There is, from analogy, probably no reason why these smooth and ornate spicules may not have belonged to the same species, but the present distinction will serve a useful purpose until more is learned of these fossils.

SPECIES OF THE HAMILTON GROUP.

DICTYOSPONGIA, gen. nov.

(For description see page 812.)

DICTYOSPONGIA (?) MARCELLIA, Clarke (sp.).

PLATE XLI, FIGS. 8, 9.

1894. *Hyalostelia (?) Marcellia*, Clarke. Thirteenth Ann. Rept. N. Y. State Geologist, vol. 1, p. 177, pl. iv, figs. 19–22.

The specimens upon which this species was based were found at the horizon of the Marcellus shales, in the excavations made at the Livonia salt shaft in Livingston county, N. Y.,* at a depth extending from 812 to 823 feet from the surface. The fossils occur as broad, thin, film like expansions which, being pyritized, make irregular splotches of discoloration, tingeing the surface of the black bituminous shales a yellowish or greenish hue. Under enlargement these patches are seen to be composed of masses of rod-like and cruciform spicules. The latter are hexactins; many of them, which exhibit four branches on the same plane, show the abbreviated or nodiform remnants of the other two rising in the plane at right angles; in some, however, there seems to be no evidence of more than four rays. With these spicules are found, similarly pyritized, large and coarse spicular bands, flat, straight, thickened on the edges or in the middle, and similar in size and appearance to small blades of grass. These end abruptly at one end but taper to the other, though showing no evidence of terminating in any appliance for attachment.

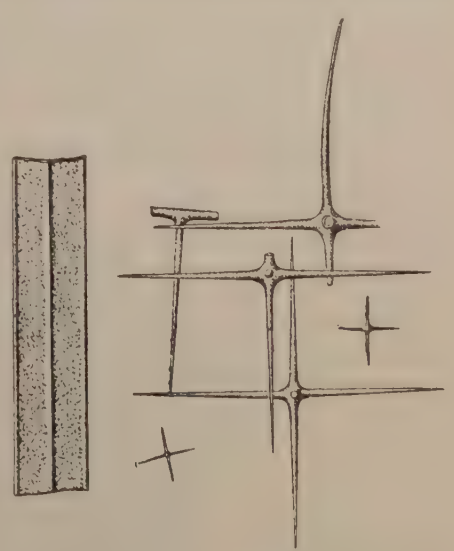


FIGURE 11. Major and minor stauractines of *Dictyospongia? Marcellia*, with portion of ligulate spicule. x 30.

There is no evidence that these broad ribbon-like spicular bands are composed of separate spicular rods; on the contrary they are clearly

*A detailed account of these excavations and the succession of the faunas through a vertical section of nearly fifteen hundred feet, is given in the work cited.

distinct and simple bodies. Their association with the cruciform spicules is so close and invariable as to enhance the probability of the organic connection of the two, and yet we do not know a similar structure among the hexactinellids. It has been impossible to gain a conception of the original form of the sponges to which these masses of spicules belong. The generic reference now made of the species is, therefore, quite uncertain.

Locality. In the Marcellus shales of the Hamilton group, Livonia, N. Y.

CLATHROSPONGIA, Hall.

(For description see page 861.)

CLATHROSPONGIA (?) HAMILTONENSIS, Hall (sp.).

PLATE XIV, FIG. 1.

1884. *Dictyophyton Hamiltonense*, Hall. Thirty-fifth Ann. Rept. N. Y. State Museum Natural History, p. 468.

SPONGE broadly cyathiform, regularly and rapidly expanding from the base. Surface apparently regularly obconical, though a sub-prismatic appearance is given to it by the very strong longitudinal spicular bands.

Reticulum characterized by the sharply elevated bands of the first order which produce large quadrules. Near the middle of the cup these primary meshes measure about 12 mm. on each side, but become smaller toward the base of the sponge where the primary bands seem to have been more or less free, but it is not clear whether these were developed into bundles of anchoring spicules independent of the reticulum. The intersections of the primary spicular bands are thickened and distinctly nodate. A second and third series of bands are more or less clearly defined, and the interspaces are very closely reticulated.

The preservation of the single known specimen of this species is peculiar and unique. The entire reticulum is compactly calcified, lying in an argillaceous shale. This calcareous matter seems to have been deposited over the inner surface of the net-work or to have replaced it from within, as traces of the finest spicular lines may be seen over the surfaces of the coarsest bands; this would indicate the posterior position of the finer net-work to the primary longitudinal and transverse bands. The elevation and prominence of the latter convey the impression that in their original condition they were extended into vertical tufts of similar character to the mural lamellae in the typical Chemung forms of CLATHROSPONGIA; the species is therefore referred to this genus until it shall have become more fully known. The lesser spicular bands abound in irregular nodose swellings which may be partially due to imperfect

preservation or to adventitious deposits of calcareous matter upon projecting points.

Dimensions. The length of the specimen is 85 mm., but neither base nor aperture is retained. Its width at the upper extremity is 100 mm.

Locality. In the Hamilton shales, shore of Canandaigua lake, N. Y.

ROEMERISPONGIA, gen. nov.

1883. *Dictyophyton*, Ferd. Roemer. Zeitschr. der Deutsch. Geolog. Gesellsch. vol. 35, p. 704, figs. a, b (p. 706).

Obconical rapidly expanding cups apparently arising from an acute base. Surface divided by strong, subequal vertical spicular bundles, crossed by narrower horizontal bands. The quadrules thus formed are all convex and appear not to be subdivided by subordinate series of spicular bands. Toward the base of the sponge the meshes are less regular than elsewhere.

Type, *Dictyophyton Gerolsteinensis*, F. Roemer.

ROEMERISPONGIA GEROLSTEINENSIS, F. Roemer, (sp.).

1883. *Dictyophyton Gerolsteinense*, F. Roemer, *loc. cit.*

In a "*Notiz über die Gattung Dictyophyton*", the late FERDINAND ROEMER described, as above cited, an interesting Dictyosponge from the middle Devonian of the Eifel. This description is as follows: "It shows, like the former fossil (*Tetragonis* [*Prismodictya*] *Eifeliensis*, F. Roemer) a surface divided into rectangular areas, but the subdivision is less regular and more simple. The vertical rods are much stronger than the horizontal rods and, inasmuch as new ones appear toward the aperture, are not quite straight. Moreover the transverse rods do not always make right angles with the vertical rods, but are, especially over the lower part, directed obliquely against them. * * * farther subdivision of the rectangular areas by finer spicules is wanting."

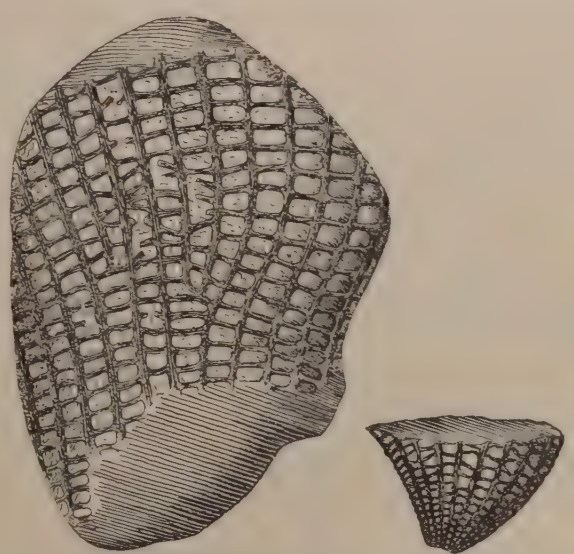


FIGURE 12. *Roemerispongia Gerolsteinensis.* (After F. ROEMER). The convexity of the quadrules is not well shown in these copies.

The two wood-cuts of this fossil given by ROEMER and reproduced here, show very clearly the structure described. The original cuts also indicate distinctly an important character which the author does not mention, namely, the convexity of each of the non-reticulate rectangular areas, which we presume to be of a similar character to the surface nodes in PHYSOSPONGIA. The relation of the fossil to the latter genus is also seen in the relatively great size and mode of reticulation of the spicular bundles, while a generic difference in the two is found in the single vertical rows of quadrules, their increase by intercalation and in the convexity of all the quadrules in ROEMERISPONGIA, even in those of irregular shape over the early portion of the cup.

Geological horizon. From the Calceola-shales, Gerolstein (middle Devonian).

Professor CLEMENS SCHLÜTER has described under the name *Protospongia rhenana*, a Dictyosponge from the Hunsrück slates (lower Devonian), of Gemünden, Germany.* The original specimen is a mere fragment of a very coarse-meshed sponge whose generic characters are entirely uncertain.

SPECIES OF THE PORTAGE GROUP.

DICTYOSPONGIA, gen. nov.

(For description see page 812.)

DICTYOSPONGIA HAPLEA, sp. nov.

PLATE XXXIII, FIG. 1.

A small species of this genus is indicated by two specimens showing a smooth, regularly expanding, subcylindrical cup with a very fine reticulum. One of these specimens exhibits only the apical portion; the other represents nearly the entire length of the cup, has a diameter rather more than one-third of the length and is slightly contracted about the aperture. No trace of prismatic faces is preserved. This entire specimen measures 40 mm. in length, 14 mm. in greatest width and 11 mm. in width at the aperture.

Locality. In the sandstones of the Portage group; second falls of the Tannery gully, Naples, N. Y. (Collected by D. D. LUTHER.)

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*Zeitschr. der Deutsch. Geolog. Gesellsch. vol. 44, p. 615, 1892.

PRISMODICTYA, gen. nov.

(For description see page 819.)

PRISMODICTYA PALÆA, sp. nov.

PLATE XXXIII, FIG. 2.

The original specimen of this species indicates a small, elongate cup, expanding rather rapidly and attaining full width at about one-third of its length from the base. Its median width is about one-fourth of its entire length and its aperture is somewhat contracted.

The surface shows that the prism-faces are distinctly developed and these are crossed by two or three low horizontal ridges making vertically elongate rectangles with the prism-angles and at their intersections are low, very small nodes.

Reticulum very fine.

The single example observed has a length of 50 mm., a median width of 14 mm. and an apertural width of 10 mm.

Locality. In the Portage sandstones; second falls of the Tannery gully, Naples, N. Y. (Collected by D. D. LUTHER.)

HYDNOCERAS, Conrad.

(For description see page 835.)

HYDNOCERAS LEGATUM, sp. nov.

PLATE XXXIII, FIGS. 5, 6.

Recent explorations have shown the presence in the Portage beds of a species which appears to be closely allied to typical forms of *H. tuberosum*, Conrad, of the Chemung sandstones. None of the material thus far collected, though from two localities, is of good quality, but enough is retained by the fragments gathered to show the presence of from four to six transverse rows of nodes which, over the lower portion of the sponge, are moderately strong and are separated by deep constrictions which bear little, if any, evidence of prismatic division. A fragment of a large individual has these nodes large, robust and blunt, similar to those in the gigantic form, *H. Avoca*, of the Chemung. (See Plate xi).

The *reticulum* is finely divided, rather more so than is usual in *H. tuberosum*. Probably additional differentiating features will appear when this Portage fossil becomes better known. For the present it seems wise to recognize the fossil by a distinct appellation, its specific value being tentative.

Dimensions. One of the specimens, somewhat distorted, has a length of 100 mm. The fragment of a large cup indicates an apertural width of 150 mm. and its original length was probably not less than 250 mm.

Localities. The first specimen found was taken from the Portage sandstone at the second falls of the Tannery gully, Naples; subsequently, the species was obtained at Varysburg, Wyoming county, in the ravine entering the village from the west. The latter horizon is considerably lower in the rock series than the former. (Collected by D. D. LUTHER.)

HYDNOCERAS EUTHELES (?).

PLATE XXXIII, FIG. 7.

(See page 845 and Plate viii, Figs. 5, 6.)

This species, characterized by its short form and long, pendant nodes, is described among the Chemung forms obtained at Cotton hill, near Avoca. A specimen from the Portage beds found in association with the preceding species, has an aspect so similar to *H. eutheles*, as to make probable the specific identity of the two. It is, therefore, for the present referred to that form. (Collected by D. D. LUTHER.)

HYDNOCERAS GRACILE, sp. nov.

PLATE XXXIII. FIGS. 3, 4.

SPONGE short, rapidly expanding, with three rows of nodes exposed, possibly a fourth near the base which is fractured. In two of these horizontal rows the number of nodes is normal, eight; but in the outer or apertural row some of the nodes are absent or but faintly developed. The apertural margin is retained in its entirety and while the absence of some of the nodes near this edge is noticeable and in accordance with the structure observed in other species, yet the nodes of this outer row are close to the margin, and not separated from it by any considerable area. The nodes of the upper row are low but those of the lower rows long and slender.

The *reticulum* is very fine, the primary subdivision being largely obscured and evidence of prismatic faces wanting. The two specimens which represent this species are similarly preserved, having been buried in the sediment without lateral compression. In their dimensions and individual characters they are very similar, though one is more favorably preserved than the other. Each has an apertural diameter of 50 mm., and their height is about 30 mm. Both of these dimensions have been somewhat modified by the slight compression

to which they have been subjected, probably the former slightly increased and the latter as much diminished.

Locality. In the flags below the Portage sandstones in the east-side ravine at Varysburg, Wyoming county. (Collected by D. D. LUTHER.)

CLEPSYDROSPONGIA, gen. nov.

SPONGE subcylindrical; subequally expanded at both base and aperture; contracted medially. Apertural margin simple, not explanate. Mode of attachment at the base not known (possibly by a transverse disk or diaphragm as in THYSANODICTYA and PHRAGMODICTYA). Surface with transverse rows of low, pointed nodes, as in HYDNOCERAS.

Type, *Clepsydrospongia matutina*, sp. nov.

CLEPSYDROSPONGIA MATUTINA, sp. nov.

PLATE XXXIV, FIGS. 1, 2.

SPONGE of moderately large size; originally subcylindrical. Diameter of basal and apertural extremities subequal; constricted medially so that the median width is about two-thirds of that at the ends. Both basal and apertural extremities appear to end abruptly, the latter showing a regular and but slightly expanded margin. The basal edge is not defined with precision but to all appearances it terminates simply as in the case of the aperture, although a transverse basal disk may have existed.

The surface shows evidence of five horizontal rows of nodes of the same character as those of HYDNOCERAS. The lowest of these is highly obscure; the second is somewhat more pronounced, as shown along the edges of the specimen. These lower rows are separated by a furrow so shallow that the surface in this region was virtually cylindrical. The third or median row of nodes is the most conspicuous of all. It is separated from adjacent rows by broad and moderately deep constrictions. The nodes also, are more strongly developed than elsewhere on the surface, are elongate and rather low. Both in this row and that following above, there are ten nodes, varying among themselves in size; those of the fourth row are not as strongly pronounced as those in the median row. The nodes of the fifth or apertural row are hardly discernible, and thus the apertural one-third of the cup and the basal one-third have a very similar aspect. These nodes are all conical and tufted.

Reticulum. The net work is very fine and sharp. The obscuration of the fundamental prism-faces makes the prevailing meshes of small size, about 1.5 mm. on each side, and though these may be again divided, combinations of them into larger quadrules are not emphasized. Thus the reticulation appears very uniform throughout.

Dimensions. The single specimen which has been observed of this species, has a length of 170 mm. Its width at the base is 65 mm.; at the aperture 75 mm.; on the median row of nodes, 60 mm.; across the median constrictions, 42 mm.

Locality. In the sandstone of the Portage group; second falls of the Tannery gully, Naples, N. Y. (Collected by D. D. LUTHER.)

SPECIES OF THE CHEMUNG GROUP.

DICTYOSPONGIA, gen. nov.

1855. *Tetragonis*, McCoy. British Palaeozoic Fossils, p. 62.

1880. *Tetragonis*, F. Roemer. Lethæa Geognostica, 1 Theil, p. 304.
Not *Tetragonis*, Eichwald, 1842. Urwelt Russlands, Heft 2, p. 81.

1883. *Dictyophyton*, Barrois. Sur les Dictyospongidæ des Psammites du Condroz, p. 85.

1890. *Dictyophyton*, Hall. Ninth Ann. Rept. N. Y. State Geol., p. 56.

Very gradually expanding, smooth, obconical or subcylindrical sponges with the outer surface devoid of nodes, tufts, ridges, annulations or other ornamentation; prism-faces sometimes very obscurely developed toward the summit; base furnished with a tuft of long, straight anchoring spicules.

Type, *Dictyophyton sceptrum*, Hall.

The fossil described by McCOY, (*op. cit.*) as *Tetragonis Danbyi*,* from the upper Ludlow rocks of Westmoreland, appears, from the description and figure given by the author and subsequently by Dr. HINDE, to be a reticulate sponge of this genus. In regard to the nature of the original species of EICHWALD's genus TETRAGONIS (*T. Murchisoni*, Eichwald), we may accept the opinion of HINDE, who says: "From an examination of undoubted forms of TETRAGONIS from the Silurian of Gotland, I believe that it is a sponge, and that it is very closely allied to ISCHADITES, Murch."

* *Dictyospongia Danbyi*; see page 803 of this volume.

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

PLATE XIV, FIGS. 3-6; PLATE XV, FIGS. 8, 9; PLATE XVI, FIGS. 3, 4; PLATE XXVII, FIG. 3; PLATE XXXVI, FIG. 7.

1890. *Dictyophyton sceptrum*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 56; and Forty-third Ann. Rept. N. Y. State Museum of Natural History, p. 258.

SPONGE elongate, conical or subcylindrical; circular or elliptical in transverse section. Usually abnormally compressed, sometimes curved. Very gradually expanding from the base upward for one-half to two thirds its length, narrowing more abruptly toward the aperture.

Surface smooth or without prism-faces or any irregularities except those arising from distortion in fossilization.

Reticulum characterized by coarse, subequidistant transverse spicular bands, from 10 to 15 mm. apart, crossed by vertical bands of subequal size not more than one-half of this distance from each other. The impressions left by the vertical bands are not as deep and conspicuous as those of the horizontal, hence the first effect produced by the appearance of the specimens is that of a strong transverse lineation, and a secondary and very characteristic impression that of a division of the surface into vertical, elongate rectangles. Some of the specimens which have been enveloped in a soft clay-shale, retain the spicular bands themselves, changed through pyritization and oxidation into limonite, a very unusual occurrence in species from the Chemung sandstones. This preservation is insufficient to demonstrate the character of the individual spicules, though it shows the very fine reticulation of the primary quadrules.

Dimensions. The specimens at hand show considerable variation in form and size. The most robust of these, in which the aperture is retained while a small part of the basal portion is lost, has a length of 200 mm., a width at the base of 40 mm., greatest width at two-thirds its length from the base, of 70 mm. and a width at the aperture of 50 mm. This specimen has unquestionably been much flattened, which accounts for its great proportional width. A more slender cup, nearly complete from base to aperture and but slightly compressed, measures 252 mm. in length and 38 mm. in greatest width. In one example the cup is greatly curved, but instances of this kind seem to be due to the easy distortion of such long and slender bodies.

Localities. In the shaly sandstones of the upper part of the Chemung group at Alfred, Scio, Friendship, Nile, Andover, Cuba and Wellsville, Allegany county; Olean, Cattaraugus county, and Jamestown, Chautauqua county, N. Y.

This species is of very frequent occurrence in the upper beds of this formation, to which it appears to be restricted. Most of the specimens found have been obtained from isolated loose blocks, though Mr. E. B. HALL, of Wellsville, has located a considerable colony of them near that village. The species is well characterized and always readily recognizable by the vertically elongated quadrules of the reticulum.

DICTYOSPONGIA LOPHURA, sp. nov.

PLATE XV, FIG. 5.

SPONGE small, slender, long, circular in cross-section; gradually expanding for one-third of its length, thence upward nearly cylindrical. Surface smooth.

Reticulum composed of fine spicular bands, apparently divisible into but two clearly defined series. The transverse bands are the more conspicuous, and their division into primary and secondary series is clearly evident, but among the vertical bands this difference is more obscure. The general aspect of the surface is that of series of vertical parallelograms whose upper and lower boundaries are the primary horizontal bands. A subordinate reticulation is visible within the larger quadrules.

The single example observed of this graceful species has a length of 88 mm. to the base of the cup. So far it is an internal cast, but beyond this point is an external cast of a spreading brush of anchoring spicules or basalia, which may be traced for a distance of 33 mm., giving the specimen, which is essentially entire, a total length of 121 mm. The width of the cup at its upper end is 7 mm. and about the same at the middle of its length.

Locality. In the upper beds of the Chemung group. Found loose at Wellsville, N. Y. (Collection of E. B. HALL.)

DICTYOSPONGIA CHARTA, sp. nov.

PLATE XV, FIG. 4.

SPONGE very small, elongate, slender and graceful; expanding rather rapidly from the base for about one-half its length, slightly contracting toward or near the aperture. Transverse section circular or elliptical. Surface smooth.

Reticulum fine, with a predominance of the horizontal bands which, with the vertical lines, produce a division of the surface into rectangular quadrules about 3 mm. in length and 2.5 mm. in width; these are subdivided into approximate squares by two subordinate horizonal bands and one vertical

band. At the apex of the best preserved specimen is the impression of a short basal tuft of spicules.

Dimensions. One example measures in length, exclusive of the basal tuft, 36 mm.; its median diameter is 4.5 mm. and its apertural diameter, 3 mm. In a second specimen two individuals lie side by side, one of them measuring 37 mm. in length, with a median diameter of 7 mm. and an apertural diameter of 4 mm. This specimen has been somewhat flattened.

Locality. In the sandstones of the upper portion of the Chemung group at Wellsville, N. Y. (Collection of E. B. HALL.)

DICTYOSPONGIA EUMORPHIA, sp. nov.

PLATE XV, FIGS. 1-3.

SPONGE small, slender, elongate-subfusiform, expanding for about one-fourth its length from the apex, thence upward with parallel sides, contracting somewhat toward the aperture. Surface smooth; reticulation very fine, composed of minute subequal rectangular meshes, whose ordinal arrangement is not clearly defined.

Two specimens of this species upon the same slab of sandstone, measure 80 and 84 mm. in length, each having a maximum width of 15 mm. In the smaller individual the aperture is retained, but in neither is the basal extremity entire. The species is distinguished from the other forms here described by its more rapidly expanding and broader cup.

Locality. In the upper beds of the Chemung group at Wellsville, N. Y. (Collection of E. B. HALL.)

DICTYOSPONGIA SIRÆA, sp. nov.

PLATE XLII, FIGS. 4, 5.

SPONGE rather small, expanding gradually, but with greater rapidity on one side than on the other, thus giving the cup a semi-crescentic outline, a feature persistent in all specimens. The shape is thus long and slender, the aperture being somewhat narrower than the parts immediately below it. The lower portion terminates in a long, narrow rope of anchoring rods whose length is nearly if not fully as great as the body of the sponge.

The *reticulum* is composed of a net-work of small quadrules of generally uniform size, not often distinctly retained. The surface shows no nodes or other irregularities.

Dimensions. A specimen entire except for a part of the anchoring rope, measures in length, from base to aperture, 72 mm., the width of the aperture

being 17 mm., and the greatest width of the cup 22 mm. Another specimen with a length of 80 mm. and not quite entire at the aperture, has an anchoring rope of 50 mm. in length and this is incomplete at its lower extremity. The persistent curvature of this species and its relatively rapid expansion, together with its remarkably long basal tuft, will serve as distinguishing characters.

Locality. Several specimens have been found in the lower beds of the Chemung group at Cotton hill, one mile north of Avoca, Steuben county, in association with *Hydnoceras tuberosum*, *H. eutheles*, *H. multinodosum*, *Arystidictya elegans*, *A. nodifera* and *Hallodictya Cottoniana.*

DICTYOSPONGIA ALMONDENSIS, sp. nov.

PLATE XLIV, FIG. 1.

The grey sandstone beds at Almond, Allegany county, are, in places, crowded with fragments of a species of very large size, but for the most part these fail to afford a definite conception of the aspect of the entire sponge. Some of these large expansions like that illustrated on Plate xliv, show under compression an obscure prismatic surface, but usually the surface is smooth and the general appearance of the accumulated fragments indicates that they belong to a single species of DICTYOSPONGIA. Among the large number of specimens collected from this locality no single one clearly shows all the specific characters. The large example given presents the maximum size observed while the accompanying figure represents the basal portion of a specimen, showing its rapid expansion and curving sides, retaining, as well, the elongate parallelograms of the reticulum which are more or less noticable in other species of DICTYOSPONGIA.

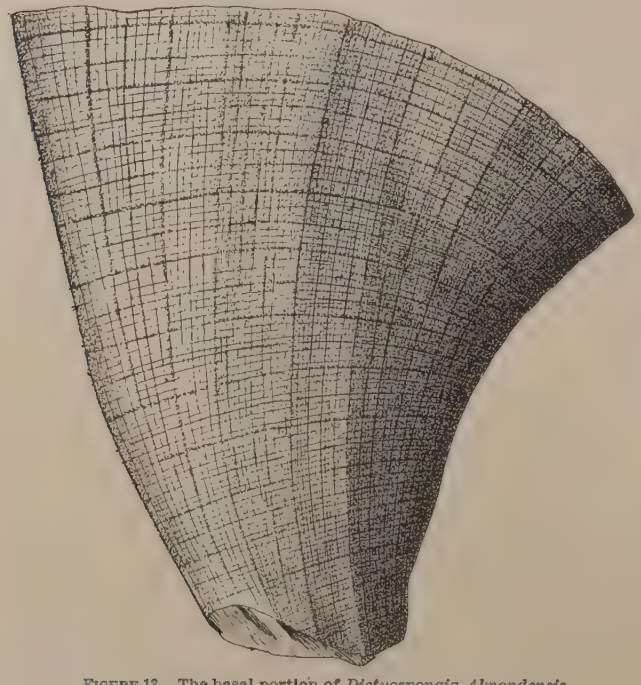


FIGURE 13. The basal portion of *Dictyospongia Almondensis.*

This is our largest species of the genus, and doubtless its great size is in itself the principal occasion of so delicate a structure being retained only in this highly fragmentary state.

Locality. Almond, N. Y. (Collection of E. B. HALL.)

DICTYOSPONGIA (?) BACTERIA, sp. nov.

PLATE XXXVIII, FIGS. 7, 8.

This is a slender, nearly cylindrical sponge, which, in the entire length, shows but slight indication of tapering in either direction. Originally its surface was doubtless smooth and this aspect is modified in the fossil only by some low casual corrugations and indentations. The substance of the skeleton was extremely thin as shown in transverse section and is represented by a tenuous ferruginous film. Under favorable light there is evident an extremely fine transverse lineation of the surface but vertical striation is extremely obscure. The fossil has a quite different aspect from the other species of DICTYOSPONGIA here described and while there is good reason to regard it as of this genus, it may prove to be of a somewhat different nature. Small patches of iron oxide on the surface of the specimen show actinic spots which, though failing to resolve under high magnification, suggest that these may be parenchymal or dermal spicules.

The length of the specimen illustrated is 110 mm. and is incomplete. Its width is 12 mm. at each extremity and 15 mm. in the middle.

Locality. From a calcareous sandstone in the upper Chemung formation, associated with numerous brachiopods: *Spirifer disjunctus*, *Orthothetes Chemungensis*, *Stropheodonta demissa* var., *Productella lachrymosa*. The precise locality of the specimen is not known, but it is probably from Steuben county.

HYDRIODICTYA, gen. nov.

1884. *Dictyophyton*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469.

Simple, broadly expanded, vase shaped cups without nodes, ridges or other conspicuous surface characters, and with no apertural spicular fringe.

Type, *Dictyophyton patulum*, Hall.

HYDRIODICTYA PATULA, Hall.

PLATE IV, FIG. 1.

1884. *Dictyophyton patulum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469.

SPONGE, of which the upper portion only is known, broadly funnel-shaped. Diameter of the aperture more than twice that at 60 mm. below the aperture. Surface marked by very faintly subprismatic and rapidly expanding faces.

Reticulum coarse-meshed, the primary quadrules being bounded by vertical spicular bands which traverse the edges and middle of the subprismatic faces and are intersected by horizontal bands of the same strength. These quadrules are trapezoidal on account of the expansion of the cup; an average example of them measures 11 mm. at the base, 15 mm. at the top and 17 mm. in height. These primary quadrules decrease greatly in size toward the aperture and are all distinctly subdivided by the impressions of three or four subordinate series of spicular bands.

The original specimen has a length of 63 mm.; an apertural diameter of 130 mm., and a diameter at the lower broken end, of 60 mm.

Locality. From the middle beds of the Chemung group, in the *Hydnoceras tuberosum* colony, at the Brown hill school-house, near Cohocton, Steuben county, N. Y.

HYDRIODICTYA CYLIX, sp. nov.

PLATE V, FIGS. 1, 2; PLATE XVI, FIG. 2; PLATE LV, Fig. 7.

SPONGE regularly conical, rather rapidly expanding; surface destitute of nodes or other ornamental characters. A small specimen bears a few irregular nodiform elevations which are, however, wholly due to the accidents of fossilization.

Reticulum regular, the prevailing meshes measuring from 2.5 to 3 mm. on each side, and being subdivided by one or two subordinate series of spicular bands. There is no grouping of these into well-defined quadrules of large size, and no evidence of the projection of the spicular bands into free lamellae.

The largest specimen observed shows a patch on its surface where the original skeleton had evidently been broken and was subsequently repaired by the formation of a highly irregular net, totally lacking the regular quadrulation of the adjoining parts of the cup.

Dimensions. A small, apparently entire individual has a length of 60 mm. and an apertural diameter of 50 mm. A larger example, which is nearly entire, is 110 mm. in length and of about the same width at the upper extremity.

Locality. In the lower beds of the Chemung group; from a shaly sandstone at Deyo basin, Naples, Ontario county, N. Y., in association with *Hydnoceras variabile*, *Ceratodictya annulata*, various brachiopods of the Chemung fauna and abundant remains of terrestrial plants.

HYDRIODICTYA NEPHELIA, sp. nov.

PLATE XXI, FIG. 10.

This species is represented by the upper portion of a flattened cup, characterized by its broadly expanded and regular aperture and perfectly smooth surface. The median or lower part of the cup tapers much less rapidly than the apertural portion.

The *reticulum* is composed of extremely fine spicular bands, those of the horizontal series being rather the more clearly defined. They occur at intervals of about 4 mm. and form, with the divergent vertical lines, somewhat trapezoidal quadrules. These spaces become obsolete toward the aperture and the entire surface is minutely subdivided by the subordinate spicular bands.

The dimensions of the single example observed are as follows: length 108 mm.; width at the lower end 65 mm.; at the aperture 125 mm.

Locality. In the upper beds of the Chemung group at Wellsville, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA, gen. nov.

1863. *Dictyophyton*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., pp. 88, 89.

1882. *Dictyophyton* (partim), Hall. Notes on the Family Dictyospongidæ.

1884. *Dictyophyton* (partim), Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 466, 469–471.

Elongate, usually slender sponges, with acute, gradually expanding base and sharply prismatic surface, the prism-faces numbering eight; aperture slightly contracted; surface without tufts or lamellar ridges; rarely with inconspicuous nodes on or between the interfacial angles.

Type, *Dictyophyton telum*, Hall.

PRISMODICTYA TELUM, Hall (sp.).

PLATE XVII, FIGS. 3–10; PLATE XXXV, FIGS. 7, 8; PLATE XLII, FIG. 2.

1884. *Dictyophyton telum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 470.

SPONGE small, sharply prismatic, octagonal in section; prism-faces flat or slightly concave. The base is broad but acute, all the prism-faces being well defined; the sponge expands rather rapidly attaining its greatest diameter at about one-third of its length, thence it contracts very gradually upward becoming narrowest at about one-fifth of its length from the upper end, again it expands slightly, and at the aperture the margin is somewhat abruptly narrowed.

Reticulum very fine, without prominent vertical bands upon the prism-faces, but showing, in a few instances, rather coarse horizontal bands. The prevailing large quadrule appears to be that which is bounded laterally by the prism-angles, and it therefore varies in width with the expansion of these faces. These major quadrules are, however, very largely obscured by the finer reticulation of the surface.

Dimensions. Entire examples of this species are not uncommon. The original specimen, which is an entire internal cast, has a length of 64 mm.; its greatest diameter is 20 mm. from the basal point and measures 18 mm.; the diameter just below the aperture is 11 mm., and the aperture itself is 7 mm. in major, and 5 mm. in minor diameter. A larger specimen is 87 mm. in length, 21 mm. in greatest diameter, and 15 mm. in diameter at the aperture.

This very neat and pretty species is distinguished by the peculiar cigar-shaped form of the cup and its persistently small size. It appears to be subject to but slight variation in these respects except such as may result from compression or other disturbances in fossilization. Occasionally an abnormal tendency to spiral growth is manifested, and one of the examples figured shows how completely this tendency may affect the entire cup. Such a result could hardly be the result of casual cause.

A block of sandstone from Wellsville is crowded with these sponges, and the exposed surfaces of nearly all the cups, especially of the larger individuals, bear numerous irregularly oblique ridges and furrows, which traverse the cup more or less completely in a spiral direction. In some instances their continuity may be traced more than once around the sponge. In one example these markings are ridges on the surface and grooves on the opposite side, the two being to a certain degree continuous; the difference in their character

is undoubtedly a matter of difference in retention. Over the surface of these markings, whether ridges or grooves, the meshes of the reticulum are distinctly seen. There is so close a resemblance in these features to tubes of annelids or those left by certain boring sponges as to justify the suggestion that we have here an indication of parasitism or commensalism of such boring or tubicolous animals with the Dictyosponges. On Plate ix (fig. 2) is given a figure of *Hydnoceras tuberosum* var. *glossema* which very distinctly shows similar vermiform markings.

Localities. In the upper beds of the Chemung group; the original specimens were derived from a locality now unknown, in Cattaraugus county. The species has been found in some abundance at Wellsville and Friendship, Allegany county, N. Y.

PRISMODICTYA BACULUM, Hall (sp.).

PLATE XVIII, FIGS. 1-3.

1884. *Dictyophyton baculum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 471.

SPONGE prismatic, distinctly octagonal, the prism-faces being flat or very slightly concave; form very gradually expanding from the base for about one-half its length, thence enlarging rapidly and again contracting toward the aperture.

Reticulum. The primary quadrules measure about 7 mm. on the edge, but distinctly enlarge in size from below upward. Each quadrule is bounded vertically by the band upon the prism-angle and by one medially dividing the prism-face. The horizontal bands have left sharply defined impressions upon the surface of the cast. The character of the reticulation is, throughout, essentially the same as that of *Prismodictya Conradi*, but the species differs from the latter in its more gradual expansion from the base upward and the absence of the peculiar nodes of that species; it differs from *P. parallela* in its distal expansion and the absence of elevated horizontal ridges with nodiform intersections.

Dimensions. The length of the best preserved example is 60 mm.; this specimen is probably but slightly imperfect at the aperture, though somewhat more at the basal extremity. Its diameter at the lower end is 26 mm.; at the greatest width, 43 mm., and at the upper end, 39 mm.

Locality. In the Chemung group at Wellsville, Allegany county, N. Y.

PRISMODICTYA SPECTABILIS, sp. nov.

PLATE XX, FIG. 5.

SPONGE large, long, rather slender; octagonal cross-section well-defined. Prism-faces flat or, at times, slightly convex along the median line; diameter gradually increasing from the base to a point distant about one-fifth of the entire length of the cup; from this point upward the width does not vary except for an abrupt contraction at the aperture. For a short distance near the base the surface of the sponge is smooth and all evidence of the prismatic faces obscured; the latter, however, rapidly become defined and are well developed at about an inch from the basal extremity. The impression of the reticulum upon the original internal cast shows a strong development of the subordinate spicular bands, the coarser meshes being pretty generally obscured. There are traces of elevated horizontal bands at intervals of about 10 mm. and these make nearly square quadrules with the prism-angles, and subordinate squares or rectangles with the median line on each face. Toward the lower end of the sponge the vertical bands are more prominent than elsewhere.

Dimensions. The specimen which has served as the basis of this description consists of two fragments, one representing the basal and the other the upper part of the sponge, a portion of the median part being lost. Judging from the slope of the sides the original length of the sponge must have been about 275 mm. The full diameter, which is attained at 75 mm. from the base, is 37 mm. and this is maintained nearly to the aperture. The sponge shows a slight curvature, but this is probably casual.

Locality. In the upper beds of the Chemung group at Wellsville, Allegany county, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA PARALLELA, Hall (sp.).

PLATE XIX, FIG. 4; PLATE XX, FIG. 6; PLATE XXI, FIGS. 8, 9; PLATE XXXV, FIG. 9.

1884. *Dictyophyton parallelum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 471.

SPONGE prismatic, elongate, slender, very gradually enlarging; prism-faces slightly convex, divided by a median vertical ridge which is somewhat elevated. Surface crossed by elevated horizontal bands at intervals varying from 8 to 10 mm.; making low nodes at their intersection with the prism-angles. The subordinate division of the reticulum is normal.

This species is not completely understood. The original specimen, which is an external cast in sandstone measuring 130 mm. in length, has a diameter of 28 mm. and evinces little, if any evidence of expansion in the cup. This, of itself, is the character which will best serve to distinguish the form from related species. The horizontal reticulation of the cup is strong, but it is probable that its relative prominence is due wholly to mode of preservation. A second specimen referable to the species retains a portion of the sponge without compression and in this the prominence of the median vertical band on each prism-face obscures the sharpness of the primary octagonal form of the cross-section, duplicating in some degree the number of prism-faces.

A third specimen, though incomplete at both extremities, has a length of 200 mm. showing that the species attained considerable length without notable variation in caliber.

Localities. The original specimen is from the Chemung group of western New York, its precise locality being unknown. Other examples of the species have been found in the upper sandstones at Wellsville, Allegany county, and at Olean and Hinsdale, Cattaraugus county, N. Y., by Mr. E. B. HALL.

PRISMODICTYA PRISMATICA, Hall (sp.).

PLATE XVII, FIG. 1; PLATE XXI, FIGS. 1–6; PLATE XLII, FIG. 6.

1882. *Dictyophyton filitextile*, Hall. Notes on the Family Dictyospongidæ pl. 17, figs. 2, 2a.

(Not *D. filitextile*, Hall, 1863 and 1884.)

1884. *Dictyophyton prismaticum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469, pl. (17) 18, fig. 2.

1889. *Dictyophyton prismaticum*, Lesley. Dictionary of Fossils, p. 200.

SPONGE regularly enlarging from base to aperture, without rapid increase in diameter at any part; somewhat variable in shape, often without perceptible expansion for a considerable portion of the cup, and with a slightly contracted aperture, but usually expanding to an aperture whose diameter is the greatest width of the sponge; sometimes curved and, not infrequently, somewhat twisted; prism-faces flat.

Reticulum as in the allied species here described, there being a median spicular band on each prism-face, with two or more accessory bands which may be more or less distinctly retained. The expression of the surface varies with the condition of preservation of the individual specimens, sometimes the

major quadrules predominating, at others these being obscured by the lesser meshes. At the intersections of the prism-angles with the horizontal specular bands, the internal casts show small pits which probably indicate the presence at those points of spicular tufts. All the principal bands, and perhaps, also the subsidiary bands, were extended laterally from the body of the cup into narrow, erect lamellae, from .5 to 1 mm. in width.

Dimensions. An average specimen which is nearly entire has a length of 90 mm.; its diameter at the base is 8 mm. and at the top 27 mm. Incomplete specimens of larger individuals having similar dimensions abound. In one specimen there is no increase in diameter in a length of 80 mm., examples of this character being of somewhat less frequent occurrence than the others.

This sponge is not widely different from those described as *Prismodictya parallela*, and when both are better known it may prove that the more regularly prismatic forms here described are identical with that species, but at present there seems no sufficient ground for separating the various forms of *P. prismatica*, all of which occur in association.

Localities. In the upper beds of the Chemung group; in great numbers in a light grey sandstone at Concord, Erie county, Pennsylvania; also at Wellsville, Allegany county, Olean, Cattaraugus county, N. Y., and at Warren, Pennsylvania.

PRISMODICTYA ALLEGANIA, sp. nov.

PLATE XX, FIG. 4.

SPONGE large, octagonal in cross-section, prism-faces clearly but not sharply defined; each divided by a more or less prominent median vertical ridge and rendered thereby somewhat convex. Basal portion rounded, the prismatic surface being undefined for about one-fifth of the length of the sponge. The expansion of the cup is gradual for nearly two-thirds of its length where the greatest diameter is attained; the upper part is considerably expanded and again contracted towards and about the aperture.

Reticulum. The prevalent major quadrules are formed by the intersection of low horizontal bands with those on the prism-angles and on the middle of the prism-faces. These average about 9 mm. across the base and 11 mm. in height. The subordinate reticulation is, as a rule, quite clearly retained to the fifth or sixth degree.

Dimensions. The largest specimen observed, which is incomplete at the basal extremity and for a short distance near the aperture, is 210 mm. in length, 53 mm. wide at the lower end and 75 mm. in diameter at the greatest

expansion, which is 70 mm. from the upper end. A somewhat smaller but more complete example has a length of 185 mm.; an apical diameter of 15 mm.; a greatest width of 60 mm. and a subapertural diameter of 50 mm.

This species bears some similarity to *Prismodictya hamula* in the expansion of the cup above the middle, but differs in its proportionally less slender form and its persistently greater size. A number of specimens from different localities all show the specific characters described.

Localities. In the upper beds of the Chemung group, at Scio and Almond, Allegany county, and Ischua and Olean, Cattaraugus county, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA CHOANEA, sp. nov.

PLATE XIX, FIGS. 1-3; PLATE XXVII, FIG. 5; PLATE XXXV, FIG. 6.

SPONGE large, elongate, rapidly expanding from the base, attaining a greatest diameter above the middle, thence somewhat abruptly contracting to the aperture. Median transverse section rounded octagonal. Surface smooth about the base, thence upward becoming faintly prismatic, these prism-faces again becoming obscure and finally obsolete toward the summit.

Reticulum fine; composed of quadrules the largest of which, over the basal portions of the cup, are bounded vertically by the edges of the prism-faces, crossed by horizontal bands at subequal distances. This makes of the main quadrules, squares measuring about 30 mm. on each side. These large areas are distinctly subdivided by one inferior series of bands, and each of these, in its ultimate division, contains approximately 256 meshes.

Toward the median portion of the sponge the prismatic faces become somewhat more obscure and the division into the quadrules of the first and second order more sharp.

Dimensions. This description is based upon specimens which represent only the lower portion of the sponge and we are not justified in inferring the character of the upper part except that while the species may assume the proportions of *Prismodictya corynia* in its later growth, it probably does not become so strongly prismatic as does that species. On the other hand, it is easy, from the obscurity of their prism-faces, to confound such specimens as those figured, with the *Dictyospongia Vanuxemensis*, the fragments of which, occuring in great numbers in the grey sandstone at Almond, sometimes show faint prismatic divisions which are wholly the result of compression.

Localities. In the upper beds of the Chemung group at Ischua and Olean, Cattaraugus county, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA CORYNIA, sp. nov.

PLATE XVII, FIG. 11.

SPONGE large, the incomplete specimen on which the species is founded indicating a greater size than is attained by any other known representative of the genus; expanding with some rapidity from the base and contracting toward the aperture. Prism-faces clearly defined, some of them with a low elevation in the median line, their edges scarcely elevated into ridges. Surface reticulated by spicular bands of subequal size, which, by intersection, form quadrules about 6 mm. square; a size which is uniformly maintained over the entire surface, except for a slight diminution toward the base and summit. This is the quadrule which impresses one as being the most prominent, though a combination of sixteen of these, four on each side, covers one-half the width of each prism-face. The quadrules are subdivided by three sets of spicular bands.

This sponge attained a size equal to that of *P. choanea*, but is readily distinguished from that species by its more sharply prismatic surface. *Prismodictya choanea* is very obscurely prismatic and in this respect approximates the normal condition of DICTYOSPONGIA.

Dimensions. Length of the specimen described, 140 mm.; probable original length not less than 240 mm.; diameter at the lower end 90 mm.; at the middle 110 mm.; at the top 90 mm.

Locality. In the upper beds of the Chemung group, Alma, Allegany county, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA FILITEXTILIS, Hall (sp.).

PLATE XXI, FIG. 7; PLATE XXVII, FIG. 4.

1873. *Dictyophyton filitextile*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 88, pl. iv, fig. 5.

1884. *Dictyophyton filitextile*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 470.

SPONGE small, slender, very gradually enlarging. Surface obscurely prismatic, the prism-faces being convex.

Reticulum extremely fine; a very sharp external cast shows that the major quadrules are formed by the intersection of horizontal bands with the prism-angles, slight nodes being made at these points. These quadrules measure about 8 by 9 mm., being somewhat higher than wide. The subordinate reticulation, however, usually obscures the larger meshes.

Dimensions. The original specimen has a length of 60 mm., a width at the lower end of 11 mm., and at the upper end of 15 mm. Essentially the same proportions are exhibited by other specimens. The species is distinguished by the obsolescence of the prism-faces, its fine reticulation and usually small size.

Localities. In the upper beds of the Chemung group. The original specimen is from some locality, now unknown, in Steuben county; others have been found at Wellsville, Allegany county, N. Y., by Mr. E. B. HALL.

PRISMODICTYA BANANO, sp. nov.

PLATE XVII, FIG. 2.

SPONGE elongate and quite slender; regularly expanding for nearly one-half its length, thence very gradually decreasing in width to the aperture; distinctly prismatic; prism-faces slightly concave.

Reticulum fine, the principal quadrules apparently being bounded by the prism angles and subequidistant horizontal bands.

Dimensions. The original specimen, which is complete at the aperture but slightly broken at the basal extremity, has a length of 120 mm. with a probable original length of 135 mm. The diameter at the lower end is 11 mm.; just below the middle, 20 mm., and at the aperture 13 mm.

This species is much more slender than any other of the forms of PRISMODICTYA except *P. amicitiæ*, and as the latter is quite distinct in size and contour, the form will be readily distinguished.

Locality. In the upper part of the Chemung group at Scio, Allegany county, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA AMICITIÆ, sp. nov.

PLATE XXXVI, FIGS. 2–4.

SPONGE small, slender, graceful, and cigar-shaped, being somewhat broadest toward the lower end just above the basal point, thence upward tapering very gradually and regularly to the aperture. In respect to this expansion of the lower part, the species resembles *P. telum*, but is a much more slender sponge than that.

The prism-faces are not very sharply defined, so that without the actual obliteration of the interfacial angles, these are rendered obscure by a general convexity of the surface, which characterizes the entire length of the sponge.

Reticulum as in other forms of this genus.

This species will be readily recognized by its persistently slender and graceful form and subprismatic surface. Among the examples figured one is given which again shows that a spiral mode of growth, such as that already shown to occur in specimens of *P. telum*, occasionally manifests itself here.

Dimensions. The best preserved specimen has a length of 90 mm. Its greatest width, one-third of its length from the base, is 13 mm.; at the aperture the width is 9 mm.

Locality. Several specimens of this form have been found in the upper sandstones of the Chemung group at Friendship, Allegany county. (Collection of E. B. HALL.)

PRISMODICTYA AULOPHIA, sp. nov.

PLATE XX, FIGS. 7, 8; PLATE XXXIV, FIGS. 4, 5; PLATE XLI, FIG. 7.

SPONGE of moderate size, gradually expanding to its full width at about two-thirds of its length, again contracting towards the aperture. Surface with deeply concave prism-faces and elevated prism-angles. Each prism-face is divided medially by a vertical spicular band, which is clearly defined on all specimens. These and the longitudinal bands upon the prism-angles, bound opposite sides of major quadrules about 6 mm. square, the reticulum over each of these areas being extremely fine. A small specimen which appears to be complete, is 50 mm. in length and 27 mm. in diameter across the upper extremity. A fragment of a larger cup measures 85 mm. in length, and the entire length, judging from the inclination of the sides, was upward of 100 mm. The concave, fluted surface of this sponge renders it unlike any other here described.

Localities. This species has been found in numbers in some blocks of compact and fine-grained red sandstone, belonging to the upper beds of the Chemung group, at Wellsville; less abundantly in greenish and more argillaceous layers at the same locality, and, also, in some abundance in a greenish siliceous sandstone at Scio, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA PTIONIA, sp. nov.

PLATE XXXIV, FIG. 3.

This sponge is of rather large size and of somewhat similar aspect to the smaller species, *P. cithara* and *P. cercidea*, the cup expanding rapidly from a narrow, doubtless somewhat extended stalk into a broad and inflated body whose prism-faces are gently concave. At, or just above, the greatest width of the sponge, low nodes are formed on the prism-angles, as in the

species cited, but are much less conspicuous than in those. Though the specimen described is incomplete, it is evident that the sponge rapidly narrowed from the line of these nodes upward.

The *reticulum* is as in other prismatic species. Along the middle of each prism-face is a conspicuous spicular band and the major quadrules which this forms with the prism-angles are clearly divided by four series of lines, all of them distinct without any one series obscuring the rest.

Dimensions. The single specimen of this form observed has a length, covering only the body of the cup, of 125 mm.; its width at the fractured base is 20 mm. and across the swollen body, 110 mm.

Locality. From the upper Chemung sandstone at Scio, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA CERCIDEA, sp. nov.

PLATE XX, FIG. 1–3; PLATE XLII, FIG. 3.

SPONGE small, fusiform, with well defined prism-faces which are flat or somewhat concave; rather gradually expanding for somewhat more than one-half its length, where its greatest diameter is attained, thence tapering with greater rapidity to the aperture which is contracted and very small. At the apex the eight prismatic faces are distinctly defined and, at the summit, these faces so nearly meet that in some instances it is impossible to determine which is the basal and which the apertural extremity. At the greatest expansion of the sponge, near the middle, there are thickenings or elongated nodes upon the prism-angles.

Reticulum fine; prism-faces devoid of prominent vertical spicular bands, while the horizontal bands are numerous but not conspicuous. The largest quadrule, measuring 4 mm. on each side, is frequently repeated, but the minor subdivisions of the net-work prevail on all the specimens observed.

Dimensions. Of three entire individuals one measures 62 mm., and two 55 mm. in length. All are somewhat compressed, but agree in having a greatest diameter of 22 mm. The apertural diameter is not more than 2 or 3 mm.

The presence of low nodes on this species shows its relationship to *P. ptionia* and *P. cithara.* To the latter *P. cercidea* is very closely allied but does not possess its long slender base.

Locality. In the upper part of the Chemung group at Wellsville, Allegany county, N. Y., associated with the lamellibranch, *Sphenotus contractus.* (Collected by E. B. HALL.)

PRISMODICTYA CITHARA, sp. nov.

PLATE XXXV, FIGS. 1–3; PLATE XXXVI, FIG. 5.

SPONGE of small size, with a very gently expanding, stalk-like basal portion which, at about mid-length of the sponge rather abruptly widens, very gradually tapering toward the contracted aperture.

The lower part of the sponge is more or less distinctly prismatic and the faces and angles are retained over the expanded portion. Where the greatest width of the cup is attained, low, elongate nodes are developed upon the prism-angles. These are of the same character as those already described for *P. cercidea* and *P. ptionia*, being very much elongated vertically and scarcely thickened. As in the species cited, also, they appear in but a single transverse row. By distortion, the nodes in one of the specimens figured are made to appear of exaggerated size; usually they are low and obscure.

The *reticulum* is fine, as in *P. cercidea*, and the chief difference in these species is in the extended basal portion of that under consideration.

Dimensions. A large, slightly distorted but nearly entire specimen is 73 mm. long, 7 mm. wide near the base, and 22 mm. wide where most expanded. This seems to be exceptionally large size and a considerable number of others indicate prevailing less size, a normal small specimen having a length of 39 mm., a width at the base of 4 mm. and a greatest diameter of 15 mm.

Locality. In a compact siliceous sandstone of the upper part of the Chemung group at Scio, N. Y. (Collection of E. B. HALL.)

PRISMODICTYA NARTHECIA, sp. nov.

PLATE XXXV, FIGS. 4, 5.

This small species is allied to *P. cithara* and *P. cercidea;* more closely to the former, from which it differs in its more slender form, and though it is not without the median expansion of that species, yet this is very much less in degree and bears only the faintest suggestions of nodes. The slender base which it possesses in common with *P. cithara*, will distinguish it from *P. cercidea.*

But a single specimen of this little sponge has been observed. This measures 44 mm. in length, 3 mm. in width at the base, 9 mm. in width where broadest, and 5 mm. across the aperture.

Locality. In the upper beds of the Chemung group at Scio, N. Y., associated with the preceding species. (Collection of E. B. HALL.)

PRISMODICTYA CONRADI, Hall (sp.).

PLATE XVIII, FIG. 4; PLATE XIX, FIGS. 5, 6.

1863. *Dictyophyton Conradi*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 89, pl. v, fig. 2, pl. v a, fig. 2.

1884. *Dictyophyton Conradi*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 471, pl. (17) 18, figs. 3, 4, 4a.

1882. *Dictyophyton Conradi*, Hall. Notes on the Family Dictyospongidæ, pl. 17, figs. 3, 4, 4a.

SPONGE obconical, slightly arcuate toward the base; the original specimen is somewhat compressed laterally, sharply prismatic, the eight prism-faces being without evidence of median longitudinal ridges, with obscurely concave surfaces and broadly elevated margins. Toward the upper extremity are a few nodiform protuberances produced by the depression and elevation of the surfaces between the prism-angles. These nodes are low, evenly rounded and alternate in position on adjoining faces, presenting thus to some degree the aspect of the nodiform surface in the genus PHYSOSPONGIA. The specimen unfortunately terminates soon after the appearance of these nodes. The prism-angles are not modified by this configuration of the faces. On one side of the specimen, however, at something less than one-half its length from the apex, are two or three lower elevations in a transverse line on the prism-angles.

Reticulum. Each prism-angle bears the impression of a strong vertical strand of spicules, which is crossed at subequal intervals by similarly strong horizontal bands. This interval is about 5 mm. and is maintained from base to top without material increase or diminution. Where these intersect the primary bands, there are slight cavities or minute pits such as are more distinctly seen in specimens of *P. prismatica*, and which probably indicate the existence of small spicular tufts at these points of intersection. The absence of prominent vertical bands upon the surface of the prism-faces, gives to the primary division of the reticulum the aspect of a series of transverse and flat annular bands. Considering the primary quadrules to be about 5 mm. square, it is possible to trace on some parts of the specimen a division of the reticulum to the sixth degree.

Dimensions. The length of the original specimen is 130 mm.; its diameter at the apical end, 5 mm.; at one-half its length its major and minor diameters are 38 and 23 mm., while at the upper extremity these are 44 and 22 mm.

Locality. In the upper beds of the Chemung group, at Randolph, Cattaraugus county, N. Y.

GONGYLOSPONGIA, gen. nov.

Elongate, subprismatic sponges, with irregular protuberances or nodes developed on the prism-faces in single alternate or opposite vertical rows.

Type, *Gongylospongia Marshi*, sp. nov.

GONGYLOSPONGIA MARSHI, sp. nov.

SPONGE approaching PRISMODICTYA in general aspect, the prism-faces being clearly manifested throughout the length of the skeleton. The expansion from the base upward is gradual and is greatest at about two-thirds of the length from the point of attachment.

Near the base, protuberances appear on each prism-face in a vertical row. These protuberances are at first low and irregular lumps, separated from each other by more or less longitudinal depressions. With increase in the size of the sponge, the protuberances become more prominent and may show several points or apices, while the separating depressions are much deeper. When at full size the surface of the protuberances may carry several small and irregular concavities.

On adjacent prism-faces these nodes seem to correspond for the most part in position, but there are noticeable exceptions in which a depression in one row lies against a node of another. Moreover there is a frequent difference in the size and number of these projections in the various rows. Irregularity in all traits is their leading characteristic.

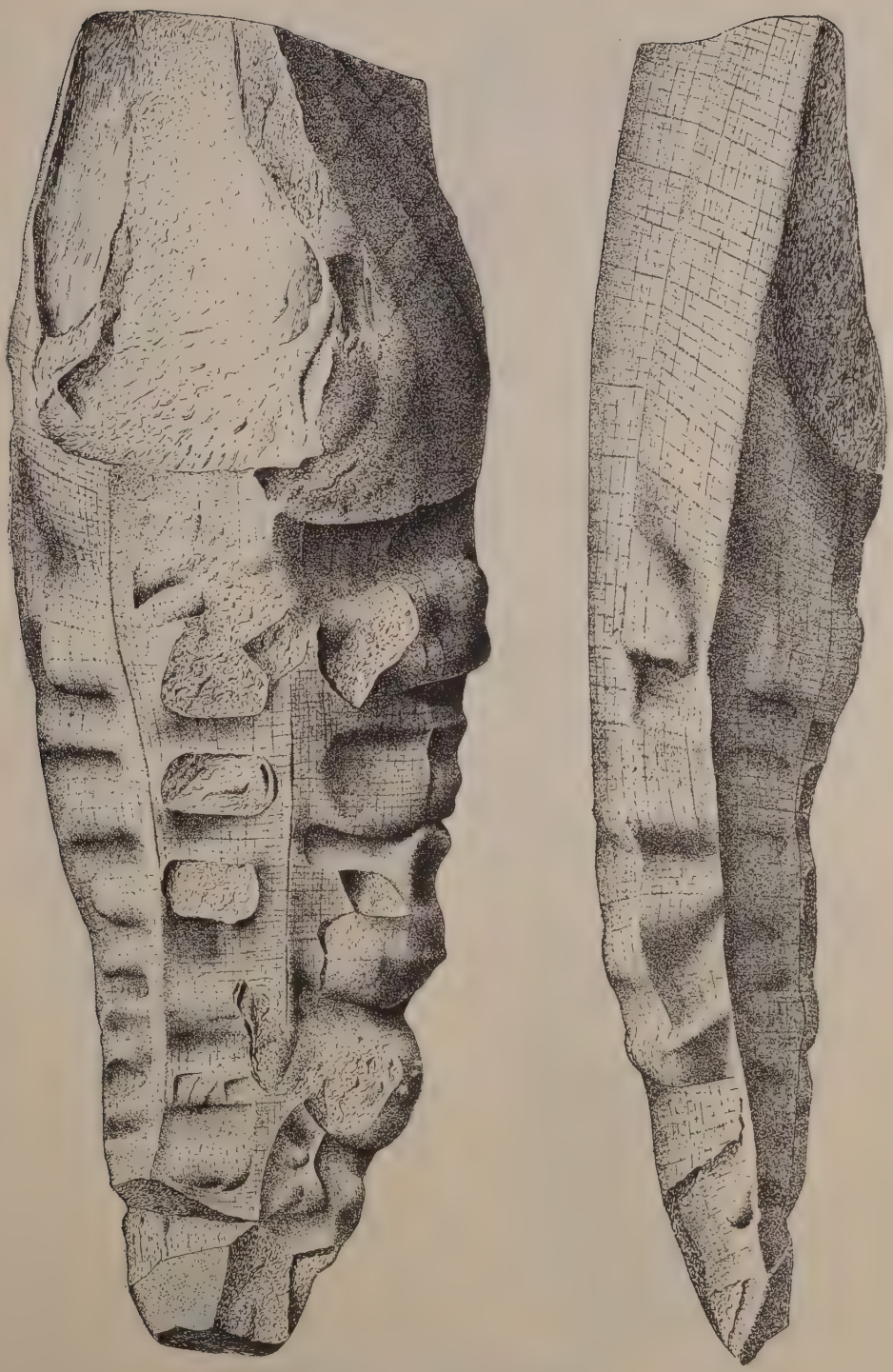
The prism-angles are pretty sharply developed between these rows of nodes and on some of the faces the vertical angles of the second order are seen to traverse the nodes.

After the maturity and full size of the sponge has been attained, the node-like irregularities rapidly disappear and all the later portion of the sponge is free of them. Over the apertural region, hence, the prismatic and primitive form of the sponge is strikingly manifested.

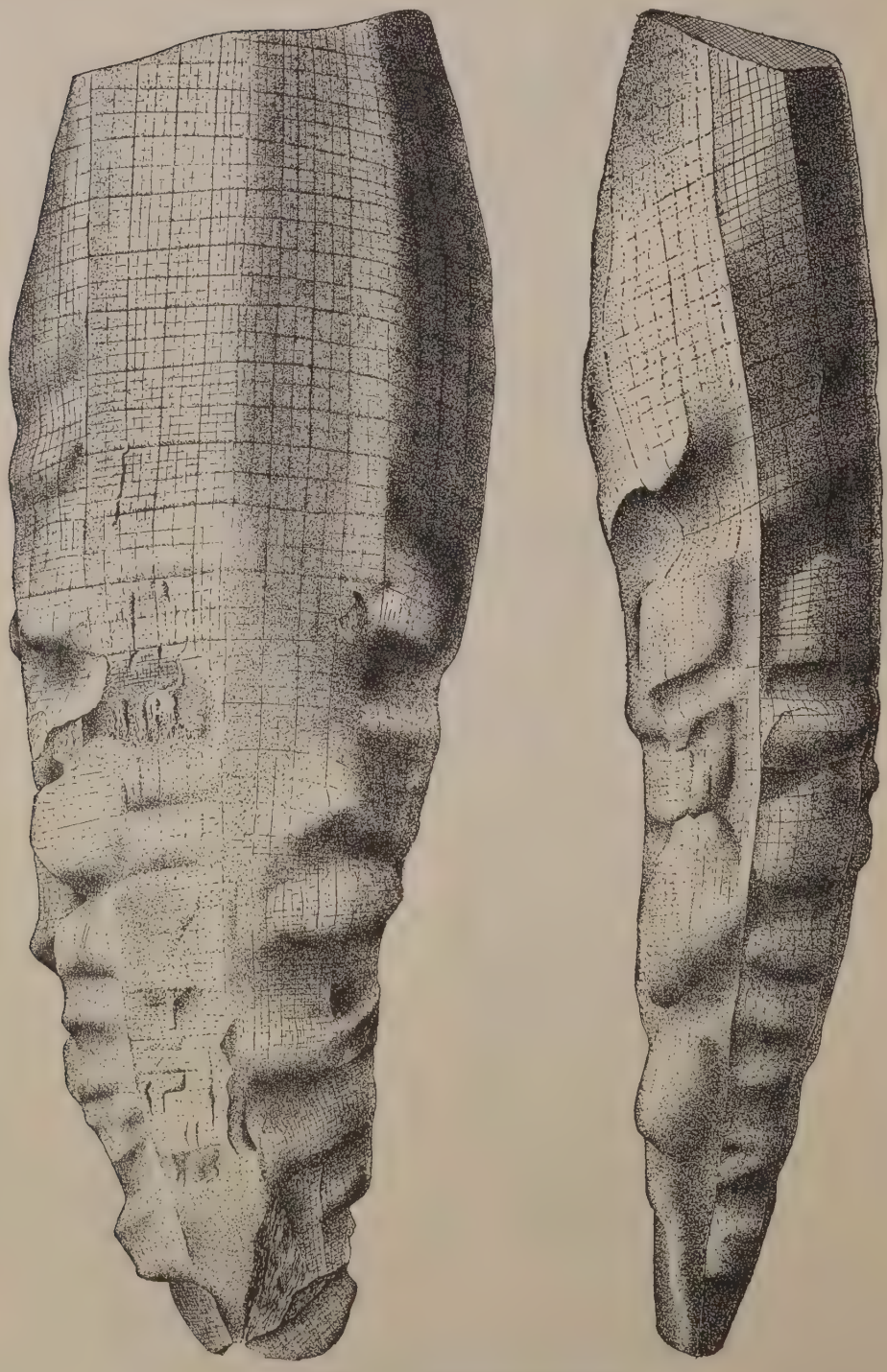
Reticulum as in PRISMODICTYA.

Dimensions. The single specimen found of this interesting species is represented in the accompanying illustrations. Its length is 190 mm.; greatest width (under some compression) 70 mm., and apertural width 55 mm.

Locality. In the Chemung beds at Wellsville, N. Y. (Collection of E. B. HALL.) Named for Professor O. C. MARSH, of New Haven, Conn.



FIGURES 14, 15. *Gongylospongia Marshi.*



FIGURES 16, 17. *Gongylospongia Marshi.*

Observations. The tendency among Dictyosponges of prismatic foundation to produce nodes upon the surface, manifests itself in two ways; these nodes develop either along the prism-angles, as in HYDNOCERAS and BOTRYODICTYA, or on the prism-faces, as in *Prismodictya Conradi*, GONGYLOSPONGIA and TYLODICTYA. In the last named genus, however, the prismatic foundation is almost completely suppressed, although the nodes show very much the same irregular characters as in *Gongyl. Marshi.*

The characters of *Prismodictya Conradi* have already been pointed out. The single specimen known of the species shows, near the fractured upper end, an obscure nodation on several of the sharp prism-faces. These are gentle and regular convexities and concavities lying in alternating rows. How irregular they may have become in later growth it is, of course, impossible to say, but the most primitive form of the node in *Gongyl. Marshi* is of more complicated shape than the nodes shown in *Prism. Conradi*, while in the latter even these simple nodes appear at a distance from the basal point which, in *Gongyl. Marshi*, covers nearly the entire growth of the sponge to maturity. It seems quite clear that *Prism. Conradi* exemplifies a primitive stadium of GONGYLOSPONGIA.

HYDNOCERAS, Conrad.

1842. *Hydnoceras*, Conrad. Journal Philadelphia Academy of Natural Sciences, vol. viii, p. 267.

1863. *Dictyophyton*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., pp. 84, 87, 90, 91.

1874. *Dictyophyton*, Larkin. The Alfred Student (May), p. 53.

1879. *Dictyophyton*, Schimper. Zittel's Handbuch der Palaeontologie; Palaeophytologie, p. 69.

1880. *Dictyophyton*, F. Roemer. Lethæa Palæozoica, p. 128.

1881. *Dictyophyton*, Whitfield. American Journal of Science, vol. xxii, pp. 53, 132.

1882. *Dictyophyton*, Whitfield. Bull. No. 1, Amer. Mus. Nat. Hist., p. 10.

1882. *Dictyophyton*, Zittel. Neues Jahrb. für Mineral., etc., vol. ii, p. 203.

1883. *Dictyophyton*, Barrois. Ann. de la Soc. Géol. du Nord, vol. xi, pp. 80–86.

1883. *Dictyophyton*, Hinde. Cat. Fossil Sponges British Museum, p. 130.

1884. *Dictyophyton*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 466, 472, 473.

1887. *Dictyophyton*, Hall. Sixth Ann. Rept. N. Y. State Geologist, pp. 36–38.

1889. *Hydnoceras*, Beecher. Mem. Peabody Museum, vol. ii, pt. 1, p. 14.

1889. *Dictyophyton*, Neumayr. Die Stämme des Thierreichs, p. 228.

1895. *Dictyophyton*, Zittel. Grundzüge der Palaeontologie, p. 52.

Obconical, more or less rapidly expanding sponges, with an acute or subacute base furnished with a short, often obscure tuft of anchoring spicules. The surface, in elementary stages smooth, soon develops eight prism-faces and thereafter prominent nodes arranged in horizontal and vertical rows, each node normally lying at the intersection of adjoining prism-faces. These nodes, therefore, correspond in number with the prism-angles, and are normally eight in any horizontal row; the number of horizontal rows in the adult condition varying from four to eight. Abnormalities in place of appearance of the nodes are not infrequent. The nodes may be small and acutely triangular or very broad and semi-ovoid in outline. The extremity of each is furnished with a small tuft of spicular rods. By the development of the nodes the prism-faces of the body of the sponge are greatly obscured. The surface also bears short erect lamellae connecting the nodes of any vertical row, and it is probable that there were similar erect lamellae, both vertical and horizontal, which correspond to the principal reticulating bands. About the aperture the surface is slightly expanded and the margin is smooth and free of prostalia.

Type, *Hydnoceras tuberosum*, Conrad.

Notwithstanding the fact that CONRAD'S term HYDNOCERAS, based upon the now well known species, *H. tuberosum*, was introduced under the conception that the fossil represented an aberrant or extravagant type of orthoceran cephalopod, there is nothing in the etymological construction of the name that of itself conveys any erroneous notion of the structure. Consequently it seems proper to rehabilitate this finely characterized genus of sponges with its first appellation, and restore to Mr. CONRAD the credit for its discovery and first description. It was, in fact, at Mr. CONRAD'S own suggestion, that his name gave way to the later term DICTYOPHYTON,* and, as elsewhere observed, although this term has been generally adopted in the literature of these fossils, it seems the wisest plan to discontinue it, not because it was founded on a misconception but because it perpetuates one. The specified type-species of DICTYOPHYTON were three in number, representing according to our present

* See Sixteenth Ann. Rept. N. Y. State Cab., p. 87.

understanding three distinct genera; none of these, however, are nodose species of the HYDNOCERAS type.

The genus is well characterized, definitely restricted and most abundantly developed in the Chemung sandstones of New York.

HYDNOCERAS TUBEROSUM, Conrad.

PLATE II, FIGS. 5–7; PLATE III, FIGS. 1, 2, 4; PLATE IV, FIGS. 2–4; PLATE V, FIGS. 3, 4; PLATE VI, FIG. 3; PLATE VII, FIGS. 2, 3; PLATE VIII, FIGS. 1, 2; PLATE XXXVIII, FIGS. 1, 2.

1842. *Hydnoceras tuberosum*, Conrad. Journal Philadelphia Academy of Natural Sciences, vol. viii, p. 267, pl. xvi, fig. 1.

1863. *Dictyophyton tuberosum*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90, pl. iii, fig. 1.

1880. *Dictyophyton tuberosum*, F. Roemer. Lethæa Palæozoica, part 1, p. 128.

1883. *Dictyophyton tuberosum*, Hinde. Catalogue Fossil Sponges British Museum, p. 130, pl. xxviii, fig. 3.

1884. *Dictyophyton tuberosum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 473, pl. 17 (18), figs. 7, 8.

Not *Dictyophyton tuberosum*, Barrois. Annales de la Soc. Géol. du Nord, vol. xi, p. 82, pl. 1, figs. 1a–e. 1883.

SPONGE of ample dimensions, turbinate or obconical, expanding with regularity and moderate rapidity; aperture not contracted. Transverse section of the body of the cup normally subcircular or obscurely octagonal, but usually subelliptical from compression. Surface bearing strong, elevated, subangular nodes which are distinctly arranged in two series, one horizontal, the other longitudinal. The horizontal rows do not, in any mature individual observed, exceed four or five, and each row is separated from the next adjacent by a regularly and broadly concave constriction. The vertical rows are, normally, eight in number, and these usually present the aspect of four double rows, the concavity of the surface between adjoining double rows being noticeably deeper than that between nodes of the same double row. The effect of this arrangement into double rows is heightened by the compression of the cup. The nodes are low, subacute or blunt, with broad bases connected vertically by sharp, slightly elevated ridges which cross the transverse constrictions, and horizontally by quite shallow depressions. In the most slender examples the height of these nodes, measured from the greatest depth of the horizontal constrictions, is not more than one-seventh of the full diameter of the cup; in robust individuals and young sponges it is very much less.

These nodes lie at regular intervals along the margins of appressed prismatic longitudinal faces, and, presumably, at the intersection of such ridges with horizontal spicular bundles of the first order. Instances of irregularity in the development of these nodes are very frequent, indeed it is rarely that the normal number and order of the nodes is retained in full-grown examples.

Reticulum. The specimens of this species are preserved as external and internal casts in sandstone. The very extensive material which has been under examination has not furnished a single instance in which the parts of the spicular skeleton have been indicated except as impressions in the sandstone. Such impressions are, however, very sharp, and afford a complete conception of the gross structure of the skeleton. The surface is very regularly reticulated by vertical and horizontal series of spicular bands. The vertical bands of the first order are, as already observed, those along which the vertical rows of nodes are arranged and correspond to the angles of the elementary prism-faces; the horizontal bands passing over the nodes do not, however, appear to be perceptibly larger than their neighbors. The general appearance presented by the surface is that of regular quadration by subequilateral rectangles, whose size varies with the individual, and the number of which between any two nodes in a vertical row also appears to be an individual peculiarity. In a slender example, one of these quadrules measures approximately 5 mm. on each side and there are nine of them between two nodes, while in a very robust individual they measure about 10 mm. on each side and there are six between successive nodes.

When the surface is well preserved, four distinct series of rectangularly reticulating bands may be observed within each of these quadrules. External casts of the cups, broken in a favorable manner, show that the vertical bands connecting the nodes were produced beyond the surface, and this we may infer to have been the condition of all the larger bands; thus producing an exterior somewhat similar to that of CLATHROSPONGIA, though these lamellae are broader in the latter genus. As these longitudinal lamellae rise over the bases of the nodes they become much broader, expanding to form a flattened triangular tuft at the apex of each node, often greatly extended, and considerably broader than the depth of the node. From the summit of the node, at the center of this triangular expansion, extends a stout bundle of spicules to and beyond the apex of the lamella (see Plate vi, fig. 3). Upon internal casts of *H. tuberosum*, there is frequently an irregular depression or pit at the summit of each node, and it may be inferred therefrom that the proximal ends of the central tufts have left these cavities (see Plates iv and v).

Mode of growth. The young *Hydnoceras tuberosum* is an anodose, narrowly turbinate cup, in the primitive stage obconical and thereafter with eight flat or slightly convex sides. The tendency to form nodes is first indicated by low swellings a little distance above the base. At a short interval there is another row slightly more prominent than the first, but neither of these is sufficient to obscure the prismatic form of the cup (see Plate vii, figs. 2, 3; Plate viii, figs. 1, 2).

It has been mentioned above that four or five transverse rows of nodes characterize the adult of this species. This statement is intended to refer only to the fully developed nodes, which may be preceded, over the basal and prismatic parts of the cup, by one or two rows of incipient nodes; further, individuals will occasionally bear a subapertural row of low supernumerary nodes. The frequent irregularity in the development of the nodes is due to various causes. A node may fail to appear at its proper place without causing any irregularity in the reticulum (compare Plate ix, fig. 2, where in the two lower rows there is one node wanting, the normal number being filled only in the third row by the abrupt appearance of a full-sized node). Many of these irregularities of development or growth are due to injuries to the cup, which the sarcode of the animal quickly repaired, but the net-work once broken was rarely fully restored to its proper pattern. Figure 2 on Plate vii shows a cup which suffered a rent or break in the net-work at an early stage of development, and this has left its traces in all subsequent growth. The irregularity shown in figure 1, Plate iii, apparently produced by some accident to the cup, has most effectually modified the shape of the sponge. On Plate vii (figure 3), is shown a cup on which, as a result of injury, a node lies in one of the horizontal constrictions and produces a slight deformation, from which the sponge shortly recovered. The disappearance of the nodes towards the aperture may be abrupt or gradual. The apertural surface is moderately broad and smooth, distinctly expanded, and, as shown in several instances, not fringed or tufted on the margin as in the lower Carboniferous genus LEBEDICTYA.

The characters of this species as above given have been chiefly derived from specimens obtained at the locality known as the Brown hill school-house, four miles west of Wallace, Steuben county, N. Y. A remarkable colony of these sponges was there discovered in 1877, when, by the grading of an old road, several hundred specimens of the species were turned out of the superficial rock-beds, and since that time systematic operations have produced many more. It has been found that this colony is quite restricted in its

extent, though it is highly probable that its resources are not yet exhausted. Probably not less than two thousand specimens have already been collected at this spot within a radius of five hundred feet from the district school-house situated on the roadside. The species occurs here almost to the exclusion of other organic remains. We have a record of three other sponges, *Hydnoceras rhopalum*, *Hydriodictya patula* and *Actinodictya placenta*, represented by single specimens, and also of a few crinoids and an occasional brachiopod. It is especially important to observe that in this prolific development, variations from the specific type, so far as the great amount of material studied would indicate, are altogether rare, if not absent. The uniformity of specific characters is maintained throughout all the variations in size and development. In the vicinity of this locality specimens have been found at various points within a mile to the west and south, and all of these occurrences appear to be at about the same geological horizon; they may prove to be offshoots or extensions of the *Brown hill colony*.

Elsewhere the species occurs in its normal proportions at somewhat widely separated localities in the northern part of Steuben county and the southern part of Ontario county. A short distance north of the village of Avoca, on the land of the late THOMAS COTTON, specimens occur in abundance but in an inferior condition and showing a constant tendency to assume the characters normal to the species *H. Avoca;* they have recently been found in great numbers by Mr. D. D. LUTHER, about two miles southeast of the village of Naples, Ontario county. The species has, in fact, the most general distribution in the Chemung rocks of any of the Dictyosponges, but it does not range high in this series of faunas; although the specimen described by CONRAD was stated to have come from Addison, Steuben county, no examples of the species from so high an horizon have come under our observation.

The discovery of similar nodose sponges in the Psammites du Condroz, of France, the equivalent of the Chemung sandstones of New York, has been recorded by BARROIS.* The fossil which this author has referred to *Dictyophyton tuberosum*, Conrad, seems to represent a species clearly distinct from any of the known American nodose forms, as is indicated by its deep horizontal constrictions, sharp prismatic faces and low carinate nodes situated on broad and stout horizontal annulations. This fossil is described and figured elsewhere in this volume under the name, *Hydnoceras Barroisi*, and in

* Sur les Dictyospongidæ des Psammites du Condroz; (Annales de la Société Géologique du Nord, vol. xi, p. 80, pl. i, 1883).

connection therewith other nodose species from the same formation, most kindly submitted by Professor BARROIS.

Dimensions. The material studied shows wide differences in respect to size. Some comparatively small individuals indicate full growth, while occasionally much larger specimens evince immaturity in the development of the nodes. The specimen figured on Plate v (fig. 4), is a very good example of an average individual, its original length having been about 200 mm. A large but slender cup has a length of 280 mm., with a greatest diameter of 95 mm., while a shorter example, 220 mm. in length, has a maximum width of 135 mm.

Localities. In the lower and middle portions of the Chemung sandstones; in the town of Italy, Yates county, and in the southern part of Naples, Ontario county; at various localities in Steuben county principally west of the Cohocton river, Brown hill school-house, Potter hill, scattered localities in the towns of Howard and Avoca. The species also occurs, though rarely, in the Jenks quarry at Bath.

HYDNOCERAS TUBEROSUM, Conrad,

VAR. GLOSSEMA, var. nov.

PLATE VII, FIGS. 4, 5; PLATE IX, FIG. 2.

This name is introduced for a form distinguished from *H. tuberosum* by its slender, very gradually expanding cup, with low, horizontal constrictions and depressed, subacute nodes in five or six well-developed rows. The variety is based upon several specimens whose dissimilarity from forms of *H. tuberosum* is very apparent. In both of the specimens figured the spicular net-work is finer, that is the principal quadrules are smaller than in *H. tuberosum*. The specimen on Plate ix, fig. 2, is interesting for the traces it shows of annelidan tubes, suggesting a commensalism, similar evidences of which have been observed in other Dictyosponges. (See page 821, and also remarks on Symbiosis in the Hexactinellida, page 761.)

Locality. In the sandstones of the Chemung group, in New York. Both examples are from unknown localities, but probably from the middle portion of the group in northern Steuben county.

HYDNOCERAS BATHENSE, sp. nov.

PLATE III, FIG. 3; PLATE VIII, FIG. 4; PLATE IX, FIG. 1.

This species has the same general form of cup as *Hydnoceras tuberosum*, but is distinguished from that by the greater number of horizontal rows of

nodes in the mature individual, there being usually five or six well developed rows, and also by the size of the nodes themselves, which are strongly elevated, compressed laterally and have an elongated semielliptical or oval outline. The height of these nodes is often equal to one-third and sometimes even to one-half the diameter of the body of the cup. Their summits are almost invariably wanting, indicating a tufted reticulum at these points. The subprismatic surface of the cup is less clearly retained than in *H. tuberosum*, and the rate of expansion and the concavity of the horizontal constriction is less pronounced.

Sponges with these characters well defined have thus far been found largely localized in the neighborhood of Bath, N. Y., where the specific traits described are maintained by multitudes of individuals. Away from this locality there seems to be a progressive modification in the form of the nodes, which lose their elongate tapering outline and gradually approach their very distinct expression in the species, *H. Avoca*. The predominance of these two forms under different geographical conditions justifies their description as distinct species notwithstanding the desultory occurrence of passage forms in other localities.

Locality. *Hydnoceras Bathense* is exceedingly abundant at the Jenks quarry, one mile south-east of the village of Bath, Steuben county, where it occurs in thin shaly layers between two heavy compact beds of greenish sandstone, whose fine grain has preserved the lines of the reticulum with much distinctness. In association with it at this locality occurs an occasional specimen of *H. botrœdema*. Outside of the *Jenks quarry colony*, typical specimens have not been found.

HYDNOCERAS BOTRŒDEMA, sp. nov.

PLATE II, FIG. 4.

SPONGE rather small, slender, very gently expanding; with four horizontal rows of very strong digitiform nodes separated by deep horizontal constrictions. Over these concave areas the surface of the cup is totally without trace of the prismatic surface shown in allied species, and when uncompressed is circular in section. The body of the cup, were the nodes removed, would be very narrow and quite cylindrical. The nodes are arranged in eight vertical rows, which are, in reality, four double rows, and any two adjacent members of these double rows arise from a common and thickened base. Nearly one-half the height of these nodes from the bottom of the horizontal constriction upwards, is below the level of the concavity dividing their proximal surfaces. Thus each pair of nodes stands upon an elevated base. The

direction of the nodes of any pair is divergent and to such a degree as to bring the summits of all the nodes to about the same interval. Each node is laterally compressed and projected downward, so that each horizontal row presents a circlet of eight drooping, almost pendulous pouches.

Reticulum rather fine-meshed.

Dimensions. The species does not vary much in size. An average example measures from apex to aperture, 135 mm.; its greatest width, across the top row of nodes, is 60 mm.; the diameter of the body of the cup at the subapertural constriction is 33 mm.

The characters of this species are pronounced and readily recognized. Its small size, subcylindrical body, elevated rows of double nodes, and the elongate, recurved form of the latter give it an expression not otherwise reproduced.

Locality. The species occurs in hundreds at a locality known as Irish hill, near the village of Bath, Steuben county. All the specimens that have been examined from this spot (the *Irish hill colony*) were found loose in the fields and no systematic excavation has been made for them into the underlying rocks. It also occurs, though not abundantly, in association with *H. Bathense* in the *Jenks quarry colony.* Away from the immediate vicinity of Bath the fossil has not been observed.

HYDNOCERAS AVOCA, sp. nov.

PLATE II, FIGS. 1, 3; PLATE IX, FIG. 3; PLATE X, FIG. 1; PLATE XI, FIG. 1.

This form of HYDNOCERAS is rendered very distinct by its short, broadly expanded nodes, very stout and wide at the base and with a subsemioval outline. The number of horizontal rows of nodes is usually four or five, including the incipient row near the base. The horizontal constrictions are narrow and deep, and the prismatic surface is obscurely retained. All the forms of this species observed indicate great size at maturity, as shown by the specimens represented on Plates x and xi. That on the latter plate is the largest nodose sponge yet seen and must have had a length when entire of not less than 625 mm., or about 2 feet. Reference has been made above to the occasional occurrence of passage forms from *H. Bathense* to this species, but the two represent sharp extremes of variation in the form of the nodes.

Locality. Hydnoceras Avoca is represented in the material under study by perhaps a dozen specimens from the vicinity of Avoca, Steuben county. Their precise position in the rocks has not yet been ascertained as the specimens, most of them collected by the late THOMAS COTTON of that village, have been found loose. There is no satisfactory evidence of their occurrence

in the Dictyosponge colony of *H. tuberosum* upon the farm of Mr. COTTON. The large example referred to was taken from the foundation wall of a ruined mill in the village of Avoca. A single example with the characteristic nodes of the species comes from the Jenks quarry, Bath, N. Y.

HYDNOCERAS PHYMATODES, sp. nov.

PLATE VI, FIGS. 4, 5; PLATE XXXVII, FIG. 3.

SPONGE distinguished from other species of this genus by its broadly expanded form and small, abundant nodes. The basal portion of the cup is anodate for some distance, and the eight prismatic faces are clearly apparent though somewhat obscured, the nodes of the vertical rows being connected by longitudinal ridges which are also clearly defined over their summits. Towards the base of the cup these nodes are in eight longitudinal rows, but near the middle or toward the aperture this number is increased by intercalation to nine, ten or eleven. The specimen figured on Plate vi shows the introduction of a single vertical line of nodes at the fourth horizontal row (counting the incipient row near the base), and on the opposite side of the cup the abrupt appearance of two new lines in the fifth horizontal row. The cup also shows faint evidence of an eighth subapertural horizontal row. The specimen shown on Plate xxxvii has similar irregularities in the number and appearance of the nodes. All of these nodes are low, with rounded margins and surfaces sloping nearly equally in all directions, the concavities between the members of each horizontal row being nearly as deep as those between successive rows. The horizontal constrictions are thus very shallow; they are also closely approximate and distinctly marked by the elevated edges of the vertical prismatic faces.

Reticulum fine, the various series of spicular bands not being very distinctly defined.

Dimensions. Specimens of this species are usually much compressed laterally, probably, however, without much exaggeration of the actual rate of expansion of the cup. The figured example has the following dimensions: Length, 180 mm.; greatest width, 83 mm.; height of nodes, 5 to 8 mm.; distance between the horizontal rows of nodes, about 10 mm. A larger example has somewhat stouter and less rapidly multiplying nodes.

Localities. In the schistose Chemung sandstones near Bath, Steuben county, N. Y. The species is rare at this place, and its occurrence can not be given more precisely. A specimen of much smaller size but of similar

aspect, has been found by D. D. LUTHER in the lower Chemung beds at Italy hollow, Yates county.

HYDNOCERAS HYPASTRUM, sp. nov.

PLATE VII, FIG. 1.

Among the specimens obtained from the late Rev. JONATHAN ALLEN, of Alfred, is one showing in cross-section a cup with a circular or subcylindrical body and eight very strong nodes in four pairs. Each pair is raised on an elevated base as in *H. botrœdema*. These nodes are very long and droop toward the base of the cup. Though the summits of all are broken, sufficient is retained to indicate their great size and length. The greatest diameter of the specimen between the broken extremities of the nodes is 130 mm.; the diameter of the cylindrical body, 57 mm. Though the fragment indicates a form similar to *H. botrœdema*, the nodes are proportionally larger and the cup itself of much greater size than in that species. It is probable that when better known this form will prove to be distinct from the others here enumerated.

Locality. In the Chemung group; from a greenish sandstone in association with *Cryptodictya Alleni*; probably from the lower part of the series in Steuben county, N. Y.

HYDNOCERAS EUTHELES, sp. nov.

PLATE VIII, FIGS. 5, 6; see also PLATE XXXIII, FIG. 7.

This form, which is represented by two very similar fragments from the same locality, combines in a certain measure the form of *H. Bathense* with the pendulous nodes of *H. botrœdema*. The sponges are short, expand rather rapidly and show obscure evidence of the prismatic faces; the horizontal rows of nodes were probably not more than four in number; the nodes themselves are extremely long, somewhat compressed laterally, the outline being incomplete at their extremities, thus indicating a strong spicular tuft at these points. In the elongate form of the nodes the species is even more extreme than *H. botrœdema*, while it lacks the subcylindrical body and slender form of the latter.

Dimensions. The better of the two examples has a length of 80 mm. from the aperture to the end of the third horizontal row of nodes, which could not have been far from the base of the cup. Its diameter at the aperture is 90 mm.; between the two lower rows of nodes, 38 mm. One of the nodes has a length of 25 mm.

Localities. In the schistose Chemung sandstones, on the farm of THOMAS COTTON, near Avoca, N. Y. Associated with this species here are great numbers of a coarsely meshed sponge, probably *H. tuberosum*, which is always poorly preserved; also, *H. multinodosum*, *Arystidictya elegans*, *A. nodifera* and *Hallodictya Cottoniana.* Reference has already been made to the probable presence of this species in the Portage group at Varysburg, Wyoming county (page 810).

HYDNOCERAS MULTINODOSUM, sp. nov.

PLATE XXXIX, FIG. 1.

Among the specimens from the Dictyosponge colony at Cotton hill, the great majority of which are very large though usually imperfect individuals approaching *Hydnoceras tuberosum*, are a few fragments indicating a species of this genus noteworthy in its size and the remarkable abundance of nodes. The best of these specimens is that figured, which represents the upper part of a large cup laterally compressed, as is the case with all the sponges at this locality. Three transverse rows of nodes are shown on the exposed side, the lower bearing eight, the middle one ten, and the upper, which appears to be the apertural row, seven. All are small and low. The adventitious character of many of these nodes is evident from a comparison of the different rows; thus one incipient node in the lower row is not represented in either of the others; similarly one node of the second row has no equivalent above or below, while another is represented in the top row but not in the lower. The total number of nodes in each upper row must have been not less than from 14 to 20, a feature which at once distinguishes the species. The more conspicuous nodes in the vertical rows are connected by slightly elevated ridges or remnants of the prism-angles. The apertural width of the fragment is 180 mm., its length 110 mm.

Locality. In the lower Chemung group, one mile north of Avoca, Steuben county, in association with *H. tuberosum*, *Arystidictya elegans*, *A. nodifera*, *Hallodictya Cottoniana*, etc.

HYDNOCERAS LUTHERI, sp. nov.

PLATE VIII, FIGS. 7–10.

SPONGE very small and graceful, very gradually expanding, prism-faces greatly obscured, growth usually regular. The rate of expansion from the base to the first row of nodes is greater than elsewhere except about the aperture. The nodes are well developed, with rounded extremities, and are arranged in three or four horizontal rows which are separated by very

broad depressions. When there are but three rows of these nodes, the first or lowest is sharply developed, and at times there is evidence of an obscure row in the apertural region, as shown in one of the specimens figured. When the four rows are normally developed those of the first row are small and incipient. The aperture is situated at somewhat less than the usual interval above the last row of nodes, and is expanded to nearly the full diameter of the cup at the last row. The number of nodes in each row, while normally eight, is sometimes but seven on the earliest rows.

The *reticulum* is fine, usually sharply retained, and shows primary spicular bands midway between the nodes both longitudinally and horizontally. The tufted extremities of the nodes are seldom preserved in the specimens examined.

Dimensions. Nearly all the examples of this diminutive and graceful species are entire, a most unusual occurrence among species of this genus. One such individual, mature in all its characters, has a length of 40 mm., a width at the first nodes of 8 mm., greatest width of 13 mm. and an apertural diameter of 12 mm. A somewhat stouter specimen has the same length but a maximum diameter of 20 mm. Individuals much smaller than either of these have also been observed.

Locality. In the sandstones of the lower part of the Chemung group. Nearly fifty individuals, characterized by their slender form and persistently small size, have been found by D. D. LUTHER, in a single loose slab, in Segur's gully, township of Italy, Yates county, N. Y. Specimens of *Hydnoceras tuberosum* occur in the same rock.

HYDNOCERAS RHOPALUM, sp. nov.

PLATE XXXVII, FIGS. 1, 2.

This form, found only in the Brown hill colony of *H. tuberosum*, is too unlike the latter to justify its being regarded as an abnormal individual expression of that species.

The sponge is elongate and slender, its most expanded portion at two-thirds of its length from the base, having about thrice the width of the fractured lower end. Nearly the entire lower half of the cup is devoid of well developed nodes, though showing distinctly, under compression, the prism-faces.

The number of horizontal rows of nodes is large, but the nodes themselves are seldom conspicuously developed. These rows, counting all which show incipient nodes, are eight or nine in number, and appear to bear normally eight in each row, but in several instances they are irregular in this respect,

nodes failing to appear at their proper position. The upper portion of the cup is somewhat distorted from accident and the mending of the net-work.

The *reticulum* is similar to that in *H. tuberosum.*

Dimensions. This specimen has a length of 125 mm., which is nearly the original extent of the sponge. At the lower extremity its width is 13 mm. Where broadest, the width is 36 mm.

Locality. Lower Chemung sandstone, Brown hill school house, near Wallace, Steuben county. (Collection of E. B. HALL.)

HYDNOCERAS VARIABILE, sp. nov.

PLATE XXXVI, FIG. 1; PLATE XXXVII, FIGS. 4-6.

SPONGE of moderate size; expanding slowly from the base for one-third or nearly one-half of its length, thence upward widening more abruptly over the node-bearing surface. The form is thus somewhat more slender below than in other species and is further characterized by an apparent absence of nodes over the basal region, or if not altogether absent their existence is only suggested here and there. Normally there appear to have been not more than three horizontal rows of nodes over the expanding portion of the cup. In all the internal casts representing the species these are low and the full number, eight, is seldom developed. Fragments of the lower parts of the cup are so nearly free of nodes as to fail to even suggest the genus HYDNOCERAS. Yet when a specimen is retained in its matrix, as shown in figure 1, on Plate XXXVI, this apparently anodate basal surface is found to have borne sharply defined nodes nearly to the apex. As ordinarily preserved the specimens are very variable in their general aspect, not only on account of irregularity of appearance in the nodes but also because of the irregular expansion of the reticulum. The fundamental prism-faces are almost wholly obliterated even on the basal portions of the cup.

Reticulum. The net-work appears on internal casts to be coarse, on account of the predominance of the secondary spicular bands forming meshes measuring about 2 mm. on each side. The general aspect of the reticulum is a composition of such rather coarse meshes, but these are more or less distinctly subdivided.

Dimensions. A specimen, the most nearly entire of any observed and having the nodes well developed, is 125 mm. in length and probably its original length was not less than 140 mm. At the lower end its width is 30 mm.; its greatest width 65 mm.

Locality. From the lower beds of the Chemung group, not more than one hundred feet above the Portage sandstones, at Deyo basin in the southern part of the town of Naples, N. Y.

Associated with it are *Ceratodictya annulata*, *Spirifer mesacostalis*, *Atrypa hystrix*, *Productella lachrymosa*, *Ambocœlia umbonata*. *Hystracanthus*, sp., etc. (Collected by D. D. LUTHER.)

HYDNOCERAS NODOSUM, Hall (sp.).

PLATE II, FIG. 2.

1863. *Dictyophyton nodosum*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 91, pl. iii, fig. 2.

1884. *Dictyophyton nodosum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 472, pl. 17 (18), fig. 6.

"A fragment two and a half inches in length, being an impression in shaly sandstone, preserves the marks of longitudinal ranges of rounded nodes there being six [five] nodes in each longitudinal row in the length indicated.

"This species differs from the preceding [*H. tuberosum*] in having longitudinal rows of nodes more nearly parallel, smaller and more clearly arranged in rows, while they are not angular. The surface is finely reticulated by longitudinal and transverse striae.

"*Geological formation and locality.* In the shaly sandstones of the Chemung group in Cattaraugus county (N. Y.)." (*op. cit.* 1863.)

This is a small species which appears to have some resemblance to *H. botrœdema* in its slender cup and strong nodes though possessing one more horizontal row of nodes than any examples of the latter species have yet shown. Nothing closely comparable to the original specimen has been observed, and hence our knowledge of the specific form is still quite imperfect.

HYDNOCERAS ANTHRACIS, sp. nov.

PLATE II, FIG. 8; PLATE VI, FIGS. 1, 2; PLATE XXXIII, FIGS. 8, 9.

SPONGE small, narrow and gracefully expanding for one-third of its length, thence upward gently contracting to a well-defined constriction just below the aperture.

Surface sharply prismatic for nearly one-half the length of the cup. Not until the sponge attains its full diameter do nodes appear and these manifest themselves with some irregularity. In the single entire specimen observed

there are but three transverse rows of nodes, and in the lowest row but three of the normal eight nodes are distinctly developed, three others are merely suggested while two are absent. In the second and third rows all nodes are present but are unequally developed. The fragment of a second and somewhat larger specimen shows four transverse rows of nodes. All of these nodes are small and are elongated by the prism-angles on which they lie. Their presence does not materially obscure the fundamental prismatic form of the sponge.

In full development each node is prominent, its height equalling about one-fourth of the diameter of the cup. They are directed gently downward and distinctly tufted. The upper or apertural portion of the sponge is smooth for a considerable distance and noticeably expanded. The margin is regular.

Reticulum fine, the principal spicular bands being those at the angles of the prism-faces, with a corresponding horizontal series dividing the constrictions between the nodes. The remainder of the net-work is subequally divided into quadrules measuring about 1 mm. on each side, and these are again divided by a single series of bands.

Dimensions. An entire specimen has a length of 60 mm., a greatest width of 20 mm. and an apertural width of 17 mm. Other specimens indicate about the same proportions.

A very interesting feature of this species is the retention of a pronounced prismatic surface, the late appearance of the nodes and their feeble development. Other species demonstrate the relationship of HYDNOCERAS to PRISMODICTYA, but in none is the connection so clearly shown as in this later and probably degenerate form.

Localities. A rare species, which has been observed only in the higher beds of the Chemung group, in a very compact green sandstone at Scio and Wellsville, N. Y. (Collection of E. B. HALL.)

HYDNOCERAS EUMECES, sp. nov.

PLATE XII, FIGS. 1-3.

This is a very large species with narrow, elongate, sharp nodes and narrow prism-faces. The original specimen has been greatly compressed vertically, but shows features which are not possessed by the other species of the genus. This is indicated, first by the dimensions of the fossil, the internal cast having a diameter of 180 mm., while the distance across the cup as indicated by the external impression, was about 225 mm.; a size not surpassed in any known specimens of this genus. The example affords no conclusive

evidence of the number of horizontal rows of nodes, but the nodes themselves are seen to be low and sharp, prolonged into acuminate tufts, separated from adjacent members of the same horizontal row by a shallow depression, while the horizontal constrictions between the rows are very deep. The interval between such of these nodes as are shown on the external and internal casts indicate the normal number of eight vertical rows. The spicular bands have left sharp impressions, the prevailing size of the quadrule being 6 mm. on a side, this being divided by a subordinate series of bands.

Locality. From the upper portion of the Chemung group at Alfred, Allegany county, N. Y.

HYDNOCERAS, sp.

PLATE VIII, FIG. 3.

A much distorted and broken specimen from the compact green sandstones of the upper part of the Chemung formation at Wellsville, N. Y., indicates still another species of this genus, in which the nodes are small but prominent, the prismatic faces sharply defined and concave, and the reticulum very fine. Its characters are, however, too obscure to ensure a correct diagnosis.

BOTRYODICTYA, gen. nov.

Dictyosponges consisting of two distinct parts; the lower subcylindrical or very gradually expanding and without surface ornamentation; the upper part a subturbinate cup, very strongly and complexly nodose. These two parts are divided by a sort of diaphragm evidently produced by the interweaving and thickening of the reticulum internally at the base of the cup. The upper part of this sponge has the aspect of HYDNOCERAS, the compound pouch-shaped nodes being arranged in horizontal rows; the lower part resembles DICTYOSPONGIA.

Type, *Dictyophyton ramosum*, Lesquereux.

BOTRYODICTYA RAMOSA, Lesquereux (sp.).

PLATE XIII, FIGS. 1–8.

1884. *Dictyophytum ramosum*, Lesquereux. Description of the Coal Flora of the Carboniferous Formation in Pennsylvania and throughout the United States, vol. iii, p. 827. (Second Geological Survey of Pennsylvania, Rept. P.)

1889. *Dictyophytum ramosum*, Lesley. Dictionary of Fossils, vol. i, p. 200.

Original Description: "Stem nodose or tubercular at the articulations, the tubercles projecting outside at right angles to the stem, as short branches, inflated and button-like at the apex.

"This species may be a form of *D. tuberosum*, Hall, l. c., p. 90, pl. iii, fig. 1, which has the articulations inflated into short, obtuse tubercles, some of them broken, but none prolonged as branches. The specimens I have had for examination represent the tubercles arranged in horizontal rows, as in *D. tuberosum*, but instead of being round and obtuse they are prolonged horizontally into short branches inflated into half round knots at the apex. The ribbon-like divisions surrounding the stems and branches are parallel and quite distinct.

"*Habitat.* Upper Chemung, head of Hill creek, Charleston township, Tioga county, Penna. A. Sherwood."

The foregoing description, based upon a conception of the vegetable nature of this organism, was derived from highly imperfect specimens. It might in fact, be difficult to recognize, in the absence of illustrations, the form which it is intended to portray, were it not that we have specimens collected from the same locality by Mr. ANDREW SHERWOOD, and that these represent the only nodose Dictyosponge known to occur there. The fossil has proven to be a remarkable and extremely interesting one, and by careful manipulation of the very badly collected material representing it, it has been possible to elucidate the main features of its structure.

SPONGE, in general form, stout and subturbinate, resting upon a long, subcylindrical, hollow base or pedicel. The latter expands very gradually, is subcircular in cross-section and smooth on the exterior. Toward its upper portion it broadens where passing into or joining the vase-like upper part of the sponge. Its length seems to be variable, irrespective of variations in the size of the nodiferous vase; where best preserved it is considerably longer than the vase, and even here its basal point is not retained. In this instance its width is about one-fifth that of the body of the vase, and this varies but little from top to bottom except at the proximal expansion.

Form and general aspect of the upper part or vase as in HYDNOCERAS. Body of the vase subcylindrical, somewhat rapidly expanding beneath, and slightly contracting at or near the aperture. Surface covered with a series of compound irregular, pendulous lobes or pouches which are arranged in eight vertical and four horizontal rows, these being separated by low vertical depressions and deeper horizontal constrictions. The specimens are so preserved that most of these nodes are greatly flattened and somewhat distorted from their normal shape, though those lying in the plane of lamination of the rock have generally escaped such distortion. The structure of these compound nodes is essentially as follows: Of the three lower horizontal rows, each rises

from the surface of the vase with a stout body which, at some little distance above that surface, is divided by a vertical and a horizontal groove, usually of unequal depth. These grooves make a division of the surface into four lobes of irregular form and distinctly pendulous; upon the lowest horizontal row the two lobes of the inferior division of the node are very long and confluent for a considerable distance, producing digitiform pouches. Those of the median rows appear to be somewhat less elongated, but all have a downward direction. There are some irregularities in the division of the nodes. In one instance the horizontal groove is wanting, leaving but two nodes on the lobe; in another, one of the four lobes appears to be divided into three, and the other into two parts. The uppermost, or apertural, series of nodes differs from the rest in having the lobes short and arranged singly or in simple pairs which seem not to correspond invariably in position with the vertical rows in which the lower nodes are arranged. The growth of the nodes in this row was, however, quite irregular; they are short, and while in some specimens they are erect and in others inclined downward, their normal position was probably directly outward. No specimen is sufficiently perfect to indicate precisely the number of nodes in this row.

A slight variation from the type of structure described is indicated by one example which shows a coalescence of, or an indistinctness between the first and second horizontal rows of nodes at their base and also a partial loss of the quadrilobed surface of the second row. Each specimen, however, presents its peculiar modifications in the number and form of the nodes and lobes.

Reticulum. Over the pedicel the spicular bands are extremely fine, but the reticulation is distinct. Toward the base of the cup the longitudinal bands become prominent while the horizontal bands are obscured. On the vase, the net-work is fine in comparison with that of HYDNOCERAS, and the obscurely subprismatic form prevailing in that genus is here totally lost. The quadrules of the most prominent series measure about 2 mm. on each side, and these are crossed by one or two finer series. Over the lobes the spicular bands all spread apart as in HYDNOCERAS. There is no satisfactory evidence of spicular tufts at the extremities of the nodes, though presumably such tufts existed; nor are there other spicular expansions except fine, narrow, longitudinal laminae following the courses of the larger spicular bands.

Toward the base of the cup there seems to have been a thickening of the spicular strands which on the inner or gastral side of the sponge apparently converged to an apex near the union of the cup with the pedicel. This internal convergence is exhibited in several instances where the sponge has been

broken transversely at this point. There is no evidence that the pedicel is filled up with spicular deposits and hence the convergence of the spicules of the cup forms a sort of diaphragm which permits a ready separation of the parts at this place.

Dimensions. Of two of the best preserved examples, one measures as follows: Entire length, 170 mm., of which 93 mm. appertain to the incomplete pedicel. Width of pedicel, 10 mm.; apertural width of cup, 68 mm. The other specimen has a length of 160 mm., of which but 63 belong to the pedicel; the median diameter of this cup is 45 mm., and the apertural width about 52 mm.

Locality. In greenish sandy shales belonging to the upper part of the Chemung group, near Lawrenceville, Tioga county, Pennsylvania.

BOTRYODICTYA (or TYLODICTYA), sp.

From the upper beds of the Chemung group at Scio, N. Y., have been obtained a few fragments of a quite small species which show compound and pendulous nodes. These doubtless represent a species either of BOTRYODICTYA or TYLODICTYA. (Collection of E. B. HALL.)

HELICODICTYA, gen. nov.

Dictyosponges with funnel-shaped or explanate skeletons, bearing equidistant spiral surface ridges.

Type, *Helicodictya trypania*, sp. nov.

HELICODICTYA TRYPANIA, sp. nov.

PLATE XXII, FIGS. 1, 2.

The specimen upon which this species is founded shows an elongate, funnel-shaped cup of small size, subcylindrical for nearly one-half its length from the base, expanding more rapidly above. Of the basal portion both external and internal casts are preserved, but of the upper part only one surface is retained. The cup is characterized by a series of strong parallel, nearly equidistant spiral ridges, from 4 to 5 mm. apart, which appear to have been extended into short, erect lamellae. The continuity of these ridges about the entire surface of the cup is clearly shown upon the internal cast.

Reticulum composed of sharply defined and minute meshes, the spicular bands lying parallel and perpendicular to the spiral ridges. The latter appear to correspond to the vertical ridges in PRISMODICTYA. The texture of the reticulum is extremely fine, there being scarcely any visible distinction in the

size of the quadrules. In some parts of the specimen the prevailing quadrule appears to be somewhat less than 1 mm. square and this is subdivided by one or two subordinate pairs of spicular bands. The entire surface shows twelve of the spiral ridges and the last two interspaces near the apertural extremity are divided medially by a much fainter ridge and elevated line.

Dimensions. Entire length of the specimen, which seems to be approximately the original length of the cup, 70 mm.; width at the base, 9 mm.; at 30 mm. above the base, 15 mm.; at its greatest diameter, 30 mm.

Locality. In the upper beds of the Chemung group at Wellsville, N. Y. (Collection of E. B. HALL.)

The following species are referred to this genus provisionally. They indicate a spiral mode of growth but their structure is too imperfectly known to render the definite determination of their generic characters possible.

HELICODICTYA (?) CONCORDIA, sp. nov.

PLATE XXVII, FIG. 2.

The single specimen of this fossil is subfusiform in outline, with a depressed upper surface; expanding from its lower, subacute extremity through somewhat more than one-half its length, thence broadly contracting without revealing any definite evidence of an aperture at the upper end, although the margin here is entire for a portion of its extent. The surface is crossed by spiral ridges at wide and enlarging intervals. These ridges are three in number and on the left margin of the specimen are about 10 mm. apart, this interval increasing on the right margin to 15 or 18 mm. The two upper intervals are each divided in the middle by a finer ridge parallel to the others. There are no reticulating ridges of corresponding size. The net-work is composed of fine spicular bands among which none is conspicuously predominant, though the prevailing quadrule measures about 2 mm. on a side and is repeatedly subdivided. The length of this specimen is 60 mm. and its greatest width 35 mm.

While this specimen presents a specific aspect rendering it distinct from associated forms, there is no very good reason for regarding it as congeneric with *Helicodictya trypania* or as a genuine spiral Dictyosponge. Upon comparison of this with the specimen figured on Plate xvii (fig. 1), the similarity in the character of the reticulum in both may be a reason for inferring that the spiral direction of the ridges in *H.* (*?*) *Concordia* may be wholly casual, as the example referred to evidently represents the apertural portion of a regularly expanding cup, whose divergent ridges are vertical.

Locality. From the upper beds of the Chemung group; in the *Prismodictya prismatica* colony, at Concord station, Erie county, Pennsylvania.

HELICODICTYA (?) SCIO, sp. nov.

PLATE XXVII, FIG. 1.

SPONGE moderately large and apparently regularly expanding. Surface crossed by subequidistant spiral ridges from 17 to 20 mm. apart, revolving from left upward and over to right. These are parallel to one series of spicular bands, the principal reticulating series making therewith quadrules measuring about 10 mm. on a side. The length of the original fragment is about 70 mm.; its width at the lower extremity 33 mm. and at the upper extremity 55 mm. Its surface bears four spiral ridges.

The reason for placing this form among the spiral sponges is simply the aspect of the best preserved specimen. While the specific form may be distinct, the evidence afforded by a second example indicates that the generic reference here provisionally employed may be of doubtful value.

Locality. In the upper beds of the Chemung group at Scio, Allegany county, N. Y. (Collection of E. B. HALL.)

RHABDOSISPONGIA, gen. nov.

Elongate, broadly and strongly annulated sponges, fluted by vertical ridges.

Type, *Dictyophyton Amalthea*, Hall.

RHABDOSISPONGIA AMALTHEA, Hall (sp.).

PLATE XVI, FIG. 1.

1890. *Dictyophyton Amalthea*, Hall. Ninth Rept. N. Y. State Geologist, p. 58; Forty-third Ann. Rept. N. Y. State Museum, p. 260.

SPONGE slender, expanding very gradually, gently curved near the base; transverse section probably circular. In the original specimen the base is wanting, but the remainder of the surface bears five broad and deep transverse constrictions which increase in width toward the aperture. These give to the cup the appearance of being strongly annulated, the annulations increasing in breadth with the constrictions. The area about and below the aperture is without constriction at the usual interval. The surface is ornamented by a series of distant, longitudinal, narrow spicular ridges, diverging toward the aperture with the expansion of the cup. Six or seven of these are visible upon the exposed surface but no other trace of the reticulum is apparent. The interspaces between these narrow ridges are flat and broad.

Dimensions. The only known example has a length of 280 mm. from the aperture, which appears to be entire, to the broken basal extremity; a width of 70 mm at the aperture and 20 mm. at the lower end.

This description is based upon a plaster cast of a specimen formerly in the possession of the late Rev. A. H. RILEY, of Montrose, Pennsylvania, but the present ownership of which is unknown.

Locality. In the upper beds of the Chemung group at Great Bend, Susquehanna county, Pennsylvania.

CERATODICTYA, gen. nov.

Elongate, gently expanding cups, transversely annulated and without predominating ridges or other surface ornamentation.

Type, *Dictyophyton annulatum*, Hall.

CERATODICTYA CARPENTERIANA,* sp. nov.

PLATE XLII, FIG. 1; PLATE XLIII, FIGS. 1–3.

SPONGE extremely elongate, slender, very gradually and regularly expanding. Sometimes the cup assumes a gentle crescentic curve which appears to be not abnormal though one specimen of considerable length is straight throughout its extent. The surface is covered by strong, regular, continuous, duplex annulations separated from each other by deep grooves, both grooves and annulations having about the same width over the median portion of the sponge. The annulations are rendered duplicate by a transverse groove on each, which under compression and especially on the incipient portions of the skeleton, may sometimes approximate in breadth the interannular grooves. Each annulation is thus divided into two well-defined ridges rounded at their summits and with their deeper slope toward the interannular grooves. Some variation is apparent in the form of these annulations during the process of growth. Near the basal point the summit grooves are relatively much broader than at any later growth-period, and although all observed specimens of the species are noteworthy for the stability and uniformity of the annulations, yet the example figured on Plate xliii (fig. 2), shows that the second annulation which is, in fact, the upper member of the divided first annulation, is itself faintly duplicate. As growth continues beyond maturity the interannular grooves become diminished in width, and apertural fragments of full grown and old specimens show that both grooves and annulations are much

* Thus named as a token of respect and esteem for Mrs. FANNIE HALL CARPENTER, daughter of E. B. HALL, Esq., of Wellsville, N. Y.

diminished in prominence, though the duplication of the latter is still more pronounced than in *Ceratodictya cincta*.

The *reticulum* is very fine-meshed throughout, with no evidence of any especially predominating series of spicular bands. The prevailing mesh measures about 1 mm. on each side and is subdivided by a single minor series. There is no evidence of any ornamental projections from the surface in the form of tufts or spicular ridges.

Dimensions. This sponge is remarkable for the great length which it attained. Plate xlii shows one excellently preserved specimen, incomplete, however, at both ends, having a length, measured along its gently curving axis, of 317 mm. In its entire length it bears thirteen double annulations, the earliest of which, measured from the outer edges of the ridges, is 15 mm. wide, and the last of them has about the same width. A second fragment (Plate xliii, fig. 2) is nearly complete at the base and is straight for a distance of 365 mm., the remainder being lost. The very long specimen shown on the same plate (fig. 1) measures 500 mm. in length, with slight curvature, and is complete at neither end. Fragments of the apertural end of full grown or old specimens found in association with those referred to, have a much greater width. One of these, doubtless of this species, is 130 mm. wide and to have attained this width at the rate of increase shown in other specimens, the entire sponge must have been not far from three feet in length. Allowance is, in this estimate, made from the very evident fact that the sponge expanded much more rapidly during the first one-third of its length than in later growth.

Localities. All the more extended specimens have been obtained in the upper beds of the Chemung group, on MILO COLE'S farm, near Ischua, Cattaraugus county. A single fragment of an old individual is from Randolph, N. Y. Associated with it in the soft greenish shales at the former locality are specimens of *Lingula*, *Camarotœchia* and *Spirifer*. (Collection of E. B. HALL.)

CERATODICTYA CINCTA, Hall (sp.).

PLATE XXII, FIGS. 7–9.

1884. *Dictyophyton cinctum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 472.

SPONGE large, subcylindrical, showing slight evidence of tapering, and though much compressed, evincing a normally circular cross-section. Surface bearing closely-set, subequidistant, narrow and strong annulations separated by furrows equal to them in width. These form a purely ornamental configuration of the surface and have no other relation to the reticulum. The reticular

net-work is extremely fine and homogeneous, no large quadrules being present. The prevailing mesh is about 1 mm. square and is subdivided by a subsidiary pair of spicular bands. These cover the entire surface both of the annulations and furrows, without the intersection of any coarse bands.

The entire dimensions of the cup are unknown. A large fragment with a length of 120 mm. bears eight annulations, the height of each being about 5 mm. The diameter of this specimen is 120 mm. On one side of the cup the growth of the annulations has been interrupted, evidently from accident, and in the repair of the reticulum the regularity of the annulations has been greatly disturbed. This species will be distinguished from the terminal expanded portions of *C. Carpenteriana* by more regularly equidistant annulations.

Locality. In the sandstones of the Chemung group; from a boulder at Erie, Pennsylvania. Portions of several individuals occur in the same fragment of rock and with them is the original specimen of *Ceratodictya zonata.* (Collection of the Philadelphia Academy of Natural Sciences.)

CERATODICTYA ZONATA, sp. nov.

PLATE XLI, FIG. 6.

1884. *Dictyophyton cinctum*, Hall (*partim*). Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 473.

SPONGE small, slender, gradually expanding. Surface crossed by broad and low annulations which are separated by narrower and shallow constrictions toward the basal extremity which is wanting. These horizontal rings are not sharply defined; those over the median and distal parts of the cup are flattened or somewhat depressed on their summit. There are eight annulations in a length of 45 mm.

Reticulum exceedingly fine, all of the quadrules being minute. The most conspicuous of the spicular bands are represented by sharp horizontal lines at the bottom of each constriction.

Length of the only observed specimen 53 mm.; diameter at the lower end, 6 mm.; greatest diameter 14 mm.

Locality. In the arenaceous beds of the Chemung group; from a boulder found at Erie, Pennsylvania. (Collection of the Philadelphia Academy of Sciences.)

CERATODICTYA ANNULATA, Hall (sp.).

PLATE XXII, FIGS. 3-6.

1863. *Dictyophyton annulatum*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90, pl. iii, fig. 3.

1882. *Dictyophyton annulatum*, Hall. Notes on the Family Dictyospongidæ, pl. 17, fig. 5.

1884. *Dictyophyton annulatum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 472, pl. 17 (18), fig. 5.

SPONGE slender, very gradually expanding, straight or slightly curved; cross-section circular.

Surface smooth, annulated by a series of low, horizontal constrictions, varying somewhat in depth, and much narrower than the successive swellings of the cup. Over the basal portion of the cup the constrictions occur at much wider intervals.

Reticulum fine, without the strong predominance of any series of spicular bands. The prevailing quadrule appears to measure about 2x3 mm., and is repeatedly subdivided.

Dimensions. The original specimens are three in number and the best of these has a length of 80 mm., and a width of 21 mm. On this specimen there are five annulations in a length of 63 mm. A somewhat larger, more completely flattened example retains nearly the entire cup, a portion of the base being wanting. The original length of the cup was about 85 mm.; the diameter of its aperture 34 mm. This specimen bears but one constriction and hence two annulations, the lower half of the cup being regularly conical.

Localities. The orginal specimens are from a sandy shale of the upper Chemung group in western New York; their precise locality, however, is not known. With them are associated the brachiopods *Ambocœlia gregaria* and *Rhynchonella duplicata.* The specimen represented on Plate xxii (figs. 3, 4) is from the lower beds of the Chemung formation at Deyo basin, Naples, Ontario county, where it is associated with *Hydnoceras variabile* and *Hydriodictya cylix.*

CERATODICTYA CENTETA, sp. nov.

PLATE XLI, FIGS. 1-5.

A small colony of annulated Dictyosponges has recently been found in a soft sandy shale which was evidently deposited about the growing cups so that the greater number of the specimens cross the sedimentation-lines of the rock at large angles, and have, in consequence, been variously compressed and

distorted. Some, which became detached or lay more nearly parallel to the lines of deposition, are better preserved, though in none of the examples is the entire form retained.

These sponges vary considerably in form and size, the young individuals being slender with broad or narrow annulations at unequal distances. The larger individuals have the annulations more regular and equidistant. All the annulations are, as a rule, low and rounded, with broad and shallow interspaces. In a specimen measuring 57 mm. in length and having a width at the upper end of 24 mm., there are six annulations at subequal intervals; a young example 46 mm. long, with a width at the top of 12 mm., and at the bottom of 7 mm., has six annulations at somewhat irregular intervals. The largest fragment observed has a diameter of 40 mm. The reticulum in all of these specimens is fine and shows no predominant spicular striae, the prevailing mesh being uniformly from .5 to 1 mm. square. The species is distinctly unlike any of the other forms referred to this genus and although having an aspect somewhat similar to that of *C. zonata*, differs from this in its less regular and unflattened annulations as well as in the character of its reticulation.

Locality. In the upper part of the Chemung group at Ischua, Cattaraugus county, N. Y. About fifty individuals were found in place distributed over a very limited area.

CLATHROSPONGIA, Hall.

1863. *Dictyophyton*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90.

1882. *Clathrospongia*, Hall. Notes on the Family Dictyospongidæ, Expl. pl. 18, figs. 3–4.

1884. *Dictyophyton* (*Clathrospongia*), Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., pp. 468–470,474.

1890. *Dictyophyton*, Hall. Ninth Ann. Rept. N. Y. State Geol., pp. 57, 58.

This term was introduced without definition and was intended to cover, in a subgeneric sense, the species *Dictyophyton abacus*, Hall, which presents a strong development of the erect reticulating surface lamellae such as also occur in the genus THYSANODICTYA. Unlike the species of the latter genus, however, the form of the cup is regularly obconical, and it appears to terminate below in an acute point. There is still some uncertainty in regard to this character, but nevertheless the differences in the form of the cups, and the characters of their earlier growth are evident. It has been found necessary in the consideration of a number of different species where imperfect preservation has precluded definite knowledge of the basal structure, to refer to this

genus some forms which, when better known, may prove to belong in some other association. Indeed, in the type-species only are the generic features clearly defined, and hence the group must for the time being serve in a measure as a convenient receptacle for certain imperfectly known forms.

Type, *Clathrospongia abacus*, Hall. (See description of this form among the species of the Waverly group.)

CLATHROSPONGIA FENESTRATA, Hall (sp.).

PLATE XIV, FIG. 2; PLATE XXV, FIG. 5.

1863. *Dictyophyton fenestratum*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90, pl. iii, fig. 4.

1884. *Dictyophyton fenestratum*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469.

The original specimen of this species is a very incomplete fragment of a moderately large cup, a portion of whose surface, involved in soft green shale, retains the exterior character of the reticulation, while the remainder of the specimen is only an internal cast of the skeleton. This specimen gives no accurate idea of the form of the cup, except that it was subcylindrical with an essentially smooth exterior, but an internal cast of a more complete example from the same locality as the original furthers our knowledge of the species.

SPONGE of considerable size, elongate subcylindrical through most of its length, with a short, rapidly expanding basal portion. Transverse section subelliptical or subcircular. Surface with only traces of low nodes at the angles of the principal quadrules.

Reticulum in its external character, composed of quadrules of which the principal series measures about 12 mm. on the side. The horizontal and vertical bands of the first series are of about equal prominence and at their intersection distinct nodes are formed. These main quadrules are regularly subdivided by four subordinate series of spicular bands and upon the internal cast almost all distinction between these series is lost, the ultimate subdivision of the quadrules being nearest the internal surface of the cup.

It is evident that the principal spicular bands were produced outward in the form of free lamellae; at one spot on the cast these show a width of about 2 mm.

Dimensions. The original specimen has a length of 105 mm. and a width of 45 mm. A second example measures 138 mm. from base to distal extremity, and for five-sevenths of this length the diameter of the cup is 45 mm. The basal cone has a length of about 30 mm.

This species bears some resemblance to *C. caprodonta* of the Waverly group, but differs from it in the smaller size of the principal quadrules of the reticulum, its more cylindrical form and more abruptly tapering base.

Locality. In the upper beds of the Chemung group, Chemung narrows, N. Y.

CLATHROSPONGIA VASCELLUM, Hall (sp.).

PLATE XXI, FIG. 12; PLATE XXV, FIG. 4.

1890. *Dictyophyton vascellum*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 57; Forty-third Ann. Rept. N. Y. State Museum, p. 259.

The original specimen of this species is a large, explanate fragment indicating a flattened cup, one of whose transverse diameters is six times the other. In its normal condition the cup must have been large, quite rapidly expanding and probably regularly conical in shape. The extreme length of the fragment is 188 mm. and the slope of the lateral margins would indicate a length from the upper edge of the specimen to the base, of 260 mm., making no allowance for the unknown extent of the cup beyond this upper limit of the specimen. The surface bears a series of low, broad vertical bands or obscure ridges, which are crossed by somewhat more obscure transverse bands, making a series of large quadrules, a little longer than broad, and measuring on an average about 26x30 mm. The specimen is an internal cast, and the intermediate series of meshes are obscured by the predominance of the ultimate and penultimate quadrules.

Several fragmentary examples of this species have been observed, all of them being somewhat water-worn. That here figured is the largest and most complete, affording specific characters not easily confounded with those of other species.

Locality. From the upper portion of the Chemung group; drift at Alfred, Allegany county, N. Y.

CLATHROSPONGIA (?) TOMACULUM, Hall (sp.).

PLATE XVIII, FIGS. 5–6; PLATE XXI, FIG. 11.

1890. *Dictyophyton tomaculum*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 58; Forty-third Ann. Rept. N. Y. State Museum, p. 260.

SPONGE long, slender, probably normally subcylindrical or very gradually expanding, though the original specimen is flattened and somewhat arched laterally. The length of this specimen is 135 mm. and neither the apertural nor basal parts of the cup are retained. Its diameter at the lower end is 50 mm. and at the upper end 60 mm.

Reticulum. The surface is covered with the fine reticulations of the ultimate spicular bands, but these do not obscure the coarse ridges of the primary bands. The latter form quadrules which are somewhat broader than long, and measure on the average 17x15 mm. The vertical bands appear to be somewhat stronger than the primary horizontal series, and this gives a slight subprismatic aspect to the surface.

This sponge is not greatly unlike *Clathrospongia fenestrata;* a more complete knowledge of both may demonstrate their identity; with our present information however, *C. tomaculum* appears to have been a rather more slender cup, with a coarser primary reticulation.

A small fragment of a second specimen retains the definition of the surface characters much more sharply. Here each of the principal quadrules is divided by a subordinate pair of spicular bands, which are nearly as prominent as those of the first order, and the finer subdivision is clearly shown in its ultimate division, each principal quadrule containing 256 minimum quadrules, produced by the intersection of five series of spicular bands.

Locality. From the upper part of the Chemung group; in a loose block at Alfred, Allegany county, N. Y.

CLATHROSPONGIA (?) IRREGULARIS, Hall (sp.).

PLATE XV, FIGS. 6, 7.

1884. *Dictyophyton irregulare*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 470.

SPONGE small, gently tapering, very faintly subprismatic. In the original specimen, which is an internal cast, these prism-faces are much obscured, partly by compression and partly, also, by the surface reticulation.

The surface is divided into major quadrules by transverse bands equidistant with the edges of the prism-faces, thus forming squares measuring about 9 mm. on a side, at each of the angles there being a low node. All of these characters are, for the most part, very obscure, but sufficient is preserved to show that, in its original condition, the sponge was divided into strong quadrules as described, these being tufted at their angles. The subordinate reticulation of the surface is normal.

Dimensions. The single example of this species is complete at neither extremity, though probably little is wanting at the upper end, and its basal extent is indicated by the slope of the sides. The length of the part retained is 65 mm.; the original length was probably not more than 75 mm. The greatest diameter of the cup is 25 mm.

Locality. This sponge was obtained many years ago at Ithaca, N. Y., by Prof. F. W. SIMONDS. Its precise position in the strata there, whether from the beds of the Portage or from those of the overlying Chemung rocks of the vicinity is not known.

CLATHROSPONGIA (?) DESMIA, sp. nov.

PLATE XXV, FIG. 3.

A fragment of the surface of a flattened cup indicates, in the absence of decisive generic characters, a species distinct from any of the forms elsewhere described. The primary and secondary spicular bands are so nearly of the same size that the surface appears to be divided into vertical rectangular parallelograms which measure on the average, 3 mm. on the base and 6 mm. in height; that is, the horizontal bands over the entire extent of the exposed surface are about twice as far apart as the vertical bands, and all leave impressions of about the same strength upon the external cast. The predominant rectangles are divided into squares, by faint transverse bands. All of the principal spicular bands form erect lamellae without producing nodes at their intersections. The form of the quadrule in this species is somewhat similar to that prevailing in *Dictyospongia sceptrum*, but we are without evidence of the existence of spicular lamellae in that species and genus. In *Thysanodictya rudis* and *T. Randalli* the quadrules are larger and more nearly square. The length of the fragment is 90 mm. and its greatest width, 40 mm.

Locality. In the upper beds of the Chemung group near Alfred and at Scio, Allegany county, N. Y.

THYSANODICTYA, gen. nov.

Subcylindrical or tapering Dictyosponges with prominent, projecting, rectangularly reticulating spicular bands or lamellae forming series of fenestrated quadrules upon the surface, as in CLATHROSPONGIA. Base ending abruptly in a transverse disk or broad and shallow reticulated obcone or basin, which may be encircled by an expanded basal frill, as in PHRAGMODICTYA.

Type, *Dictyophyton Halli*, Hall.

Species of this genus combine some of the characters of the two genera last mentioned, and while the form of the sponge is similar to that of PHRAGMODICTYA, it lacks both the irregular surface ridges of that genus and also the regularly radiated reticulum of the diaphragm or basal

surface. In THYSANODICTYA the reticulation of this surface is rendered regularly quadrate by the crossing of the strands which are vertical in the wall of the cup; the margins of the base are frequently puckered into low and irregularly disposed nodes, the peripheral frill being produced directly from this margin. The aspect of this surface is somewhat similar to that in the species *Oncosella catinum*, Rauff, from the Wenlock limestone*, although the latter is a thick-bodied sponge, and in this respect unlike THYSANODICTYA. RAUFF is disposed to believe that ONCOSELLA possessed one or more tufts of anchoring spicules, though they have not yet been found, and that, therefore, the sponge was not yet attached by this flattened base. Presumably, in THYSANODICTYA, the basal attachment was essentially effected by the encircling frill-like tuft.

It may be added that all the species of this genus now known show evidence of a sixth series of reticulating spicular bands, which produces an extremely minute ultimate division of the quadrules.

THYSANODICTYA EDWIN-HALLI, nom. nov.

PLATE XXIV, FIGS. 1–9.

1890. *Dictyophyton? (Phragmodictya) Halli*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 59; Forty-third Ann. Rept. N. Y. State Museum, p. 261.

SPONGE generally small, obconical or subclavate, narrowest above the base, rapidly expanding to the aperture; very variable in form, sometimes long and extremely slender, at other times short and stout. Base somewhat expanded, nearly flat, in some instances apparently concave; nodose on the periphery and with a broad marginal spicular frill extended downward or over the surface of attachment.

Reticulum of the lateral walls coarse, the main spicular bands forming vertically elongate quadrules measuring on an average 7x11 mm. The size of these quadrules varies greatly in different individuals and in different parts of the same individual. The subordinate reticulation even to the last degree, is often retained, but does not in any way obscure the predominance of the main ridges. These vertical and transverse ridges of the first and second series are expanded into lamellae which lie vertical to the surface of the cup and are free for a width of from 2 to 4 mm. At the base of the cup the vertical ridges thicken and form a single series of sharp, nodiform peripheral ridges which may extend for a short distance on the surface of the flattened or

* See RAUFF; Palaeospongiologie, Part 1, p. 264, pl. vii, figs. 5–10 (especially fig. 7), 1894.

depressed basal diaphragm. The basal frill (*periloph*, Rauff) is broad and where best retained appears to be gently undulated, but this expansion is not so preserved as to show clearly the character of the reticulation. The basal diaphragm is slightly convex or even concave, and bears a low but coarse rectangular reticulation.

Dimensions. A well developed individual of rather large size, measures 60 mm. from aperture to base. The aperture is 48 mm. and the base 26 mm. in diameter; the width of the cup across the constriction just above the base is 20 mm. A very slender example is 82 mm. in length, 30 mm. in diameter at the aperture, 11 mm. at its narrowest point and 13 mm. across the base which is not entire. In still another specimen, which may be somewhat compressed vertically, the length is but 20 mm., the diameter of the aperture 27 mm., and that of the base 25 mm. In an individual about 50 mm. in length and having a basal diameter of 25 mm., the basal expansion or frill has a diameter of about 17 mm. A single example surpasses the usual dimensions of the species, presenting a length of 175 mm. and even thus incomplete.

Localities. In the upper arenaceous beds of the Chemung group at Wellsville, N. Y. This usually small species has been found here by Mr. E. B. HALL in considerable quantities. About fifty specimens, all from the same spot, have been examined and these we are informed represent but a small part of the number there obtained. It also occurs at Scio, Allegany county, Ischua, and Olean, Cattaraugus county, and has been found on the Cassadaga creek in Chautauqua county.

THYSANODICTYA PŒCILUS, sp. nov.

PLATE XXIV, FIGS. 10; 11.

SPONGE somewhat variable in form; short and robust or long and slender; subcylindrical, contracting above the base for less than one-half its length, and again expanding to the aperture, whose diameter is about equal to that of the base. Basal disk very depressed, almost flat; margins thickened and also extended into a peripheral frill.

Reticulum having the general expression of that in *Thysanodictya rudis*, though the elongate rectangular primary quadrules are regularly smaller, each comprising four parallelograms measuring on an average 4x6 mm. At the base and near the aperture these areas are more nearly square. The primary spicular bands are sharply elevated, minutely nodose at their extremities upon the external cast, and both the vertical and horizontal series are carried out into broad, erect lamellae which have a diameter of from

3 to 5 mm. At the intersection of these lamellae, somewhat thickened nodes or tufts are formed which extend beyond the edges of the lamellae themselves. The aperture appears to be without evidence of a marginal tuft. The basal disk is somewhat thickened and bears ridges at the margins, but the character of its surface and that of the peripheral frill is not well shown.

Dimensions. Four examples of this species are preserved upon a single slab of sandstone. Of the best two of these, one measures 100 mm. in length; diameter at the base (exclusive of marginal expansion), 55 mm.; at the aperture, 53 mm.; at the narrowest portion of the cup, 37 mm., and, with the surface lamellae, 46 mm.; the other, a much more slender cup, has a length of 120 mm. (incomplete), an apertural diameter of 30 mm. and a narrowest diameter of 22 mm.

This species is distinguished in its stouter form, from *Thysanodictya rudis*, and in its more slender form, from *T. Elwin-Halli*, by the smaller size of its primary quadrules.

Locality. In the upper beds of the Chemung sandstones, associated with *Camarotœchia* and *Leptodesma*, Scio, Allegany county, N. Y. (Collection of E. B. HALL.)

THYSANODICTYA RUDIS, Hall (sp.).

PLATE XIX, FIG. 7; PLATE XXIII, FIGS. 1–6.

1863. *Dictyophyton rude*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., p. 90, pl. v, fig. 3.

1884. *Dictyophyton rude*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 469.

1890. *Dictyophyton scitum*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 58; Forty-third Ann. Rept. N. Y. State Museum, p. 260.

SPONGE moderately large, cylindrical. Base subtruncate, closed by a broadly obconical diaphragm. Surface sharply divided by a series of vertically elongate quadrangles which, in the middle portion of the original specimen, appear to be all of approximately the same size. Each of the quadrules of the first order embraces four of these rectangles and measures, on an average, 15x18 mm. Toward the base of the cup these primary quadrules are more nearly square. The bands of the first and second series form low nodes at their intersection and both the vertical and horizontal series are produced into erect lamellae which may extend outward from the surface for a distance of from 3 to 5 mm. The third, fourth and fifth series of spicular bands are seldom clearly developed, being to some extent obscured by the ultimate division of

the reticulum produced by the sixth series of bands. The presence of this series produces 1024 divisions in each primary quadrule. The conspicuous ridges of the lateral surfaces extend over the broad, subconical base, the vertical bands converging at the apex and the horizontal bands being distinctly concentric. The basal cone is shown in two examples, in one of which it is attached to a portion of the cup and is extremely compressed laterally. In the other, such distortion as it has undergone is in the opposite direction, vertical rather than lateral. The latter specimen represents a cup with a diameter of about 80 mm., bears a decidedly eccentric apex and shows the characteristic coarse and minute reticulation of the surface. The depth of this cup is 17 mm.

Dimensions. All specimens of this species observed are of about the same size. The original example, which is nearly entire in length though not retaining the basal cone, is 135 mm. long and 64 mm. wide. Another entire specimen has a length of 120 mm. and a width at the aperture of 70 mm.

This species is readily recognized, even in the absence of its basal diaphragm by its stout, cylindrical shape and coarse primary reticulation. It is closely allied to *T. Randalli* though rather less stout. The characters of the latter species are not, however, so well known.

Localities. In the upper beds of the Chemung group, at Little Genesee, Alma and Wellsville, Allegany county, at Ischua, Hinsdale and Olean, Cattaraugus county, and Chemung narrows, Chemung county.

THYSANODICTYA RANDALLI, Hall (sp.).

PLATE XXIV, FIG. 12.

1890. *Dictyophyton Randalli*, Hall. Ninth Ann. Rept. N. Y. State Geol., p. 57; Forty-third Ann. Rept. N. Y. State Museum, p. 259.

The specimen upon which the original description of this species was based, is the upper portion of a flattened, once cylindrical cup whose surface is covered with low longitudinal and horizontal ridges which form quadrules measuring about 17x21 mm., each of these being subdivided by secondary ridges of nearly the same prominence as the first. The subordinate cancellation of the surface is very fine. At the upper extremity of the specimen where the apertural margin is retained there is some indication of a continuation of the vertical spicular bands beyond the edge of the cup. The length of the specimen is 90 mm.; its apertural diameter is 78 mm. This form is very closely allied to *T. rudis*, though present evidence indicates that the cup was

broader and the primary surface quadrules more nearly equilateral than in that species; yet it is probable that further knowledge will demonstrate the superfluity of this specific name.

Locality. In the Chemung group, associated with *Spirifer disjunctus;* Warren, Pennsylvania.

THYSANODICTYA SACCUS, sp. nov.

PLATE XXV, FIGS. 1, 2.

SPONGE short, stout, broadest at the base, narrowing upward, with gently incurving margins. Height somewhat less than the basal diameter. Circular or subelliptical in cross-section. Basal obcone or diaphragm moderately deep with a subcentral apex.

Reticulum. Primary quadrules somewhat variable in size, smaller and more nearly square than in *Thysanodictya rudis.* Subordinate divisions of the net-work clearly shown in places. The basal diaphragm is thickened or nodose about the edges and, in the specimens observed, has a somewhat irregular reticulation, though the meshes of the lateral surfaces are here to some extent retained. This species may be recognized by its short and robust form and its tapering rather than expanding cup. Two individuals from different localities show the same characters. In the better of these, one surface is covered with low, apparently concretionary tubercles which, in a measure, obscure the character of the reticulum; a phenomenon not infrequent among these fossils.

Dimensions. A typical example has a length of 74 mm., a basal diameter of 88 mm., and an apertural diameter of 63 mm. A second specimen has nearly the same proportions.

Localities. In the upper part of the Chemung group, at Wellsville and Whitesville, Allegany county, N. Y. (Collection of E. B. HALL.)

THYSANODICTYA JOHNSTONI, sp. nov.

PLATE XXIII, FIGS. 7, 8.

SPONGE robust, subcylindrical or somewhat inflated medially, and sharply constricted above the base. Basal obcone or diaphragm very shallow, nearly flat; sharply and irregularly nodose about the margin. The surface of this diaphragm is composed of fine and sharp spicular bands intersecting at right angles, the prevailing quadrule measuring from 3 to 5 mm. on a side. There are no coarse spicular ridges of a higher order distinguishable, but the reticulum shows, in addition to the regularly intersecting bands, irregularly arranged or disordered bands principally of large size. The nodes of this basal surface

are most prominently developed at the margin, taking somewhat the form of elongated ridges directed toward a common center and hence, here and there, they are to be found extending upon the inferior surface in an irregular and desultory way. The surface of the cup, in the only example in which it is retained, is covered with low nodes or coarse papillae, arranged with some degree of regularity; they show, however, no trace of the spicular net-work. This specimen is involved in a soft arenaceous shale and these rounded bodies on the surface appear to be concretionary, as in places where the rock is exfoliated they show a succession of thin laminae. Probably they have formed about the projecting points and intersections of the principal spicular strands.

Dimensions. The most complete example observed retains a large portion of the cup which has been bent over so that it lies in nearly the same plane with the basal diaphragm. Its entire length is 135 mm.; its diameter at the upper end, 67 mm.; at the middle, 78 mm.; just above the base, 53 mm. The greatest and least diameters of the base are 70 and 55 mm. Another example preserving the base only, has the major and minor diameters 85 and 55 mm.

This species may be distinguished from *T. Edwin-Halli* and *T. rudis* by its different form, extremely nodose and finely reticulate base.

Locality. In the upper beds of the Chemung group, Wellsville, N. Y. (Collection of E. B. HALL. Named for Mr. JOHN S. JOHNSTON, of Wellsville, in recognition of his intelligent activity in collecting the sponges of the upper Chemung group.)

THYSANODICTYA QUASILLUM, sp. nov.

PLATE XXXVIII, FIGS. 3, 4.

SPONGE large and stout; general form as in the other species of the genus, with a subcylindrical body slightly expanded above the middle and at the base. The aperture is not well retained.

Surface marked by large, coarse meshes of somewhat variable size, bounded by distinct ridges which were probably bases of vertical surface lamellae. These quadrules are approximately square, the largest of them measuring about 16x14 mm. These occur about the more expanded portion of the sponge, toward the base the prevailing meshes being somewhat smaller. At the intersection of the primary bands there is a noticeable tendency to elevation in the form of low nodes. A faint subdivision of the principal

quadrules by spicular bands of the second order is visible here and there over the surface, and over the entire reticulum may be seen the extremely fine ultimate division of the skeleton. At the base the margins of the diaphragm are somewhat irregularly thickened into nodes, but the structure of the reticulum over the basal surface is not retained although the form and outline of this part are distinctly shown.

The species is distinguished from *T. rudis* and *T. Randalli* by its greater size and the coarseness of its primary meshes.

The specimen we have used for the illustration of this species shows in a very interesting manner how differently the reticulum may be retained on parts of the same individual. Figures 3 and 4 (Plate xxxviii) represent opposite sides of a specimen, on one the primary net-work only being apparent while on the other the minute ultimate division of the net is retained. This difference appears to be due to the fact that the specimen is a somewhat concretionary mass of sandstone which was involved on one side in a film of fine mud capable of retaining the impression of the most delicate spicular divisions.

Dimensions. Length of an essentially entire specimen, 140 mm.; width above the middle and at the base 85 mm.

Locality. From the Chemung group at Weston mills, Cattaraugus county, and Wellsville, Allegany county. (Collection of E. B. HALL.)

THYSANODICTYA SCYPHINA, sp. nov.

PLATE XLII, FIG. 8.

SPONGE small, subcylindrical, the original specimens being somewhat contracted at or near the aperture and having the prevailing mesh of the net-work of small size, averaging 2 to 3 mm. on a side. The species is distinguished by these characters from other members of the genus.

The basal frill is clearly retained over a portion of the lower extremity and shows a broadly crenulated or furrowed surface and an irregular margin.

Dimensions. The length of the specimen, which has been somewhat compressed vertically, is 36 mm., its basal diameter 30 mm. and the width of the basal expansion 7 mm.

Locality. In the upper part of the Chemung group, Olean, Cattaraugus county, N. Y. (Collection of E. B. HALL.)

THYSANODICTYA HERMENIA, sp. nov.

PLATE XXVII, FIG. 7; PLATE XXXIX, FIG. 2; PLATE XL, FIGS. 1–3.

SPONGE attaining large size; subcylindrical, expanded both at base and aperture. Primary quadrules of the wall of the cup very large, varying somewhat in size. These are generally longer than wide and the largest of them may measure as much as 42x21 mm. Such large quadrules generally lie over the median part of the sponge, those toward the extremities being shorter and more nearly square. The finer net-work is retained in places.

The length of a large specimen, incomplete at the aperture, is 250 mm.

Three specimens, two of which were evidently overwhelmed by encroaching sediments while growing in their normally erect position, afford a very clear conception of the structure of the basal plate or diaphragm, though the vertical walls of the cup have been so compressed as to wholly destroy their characters. In the matter of size, they can be compared only to *T. quasillum*, whose basal parts have not been precisely made out. Of these specimens one has a diameter of 150 mm., the other measuring to the edge of the peripheral frill, 175 mm., the base of the cup itself being 130 mm. in diameter.

No other examples of this genus have preserved so distinctly the structure of these basal parts and of these three specimens two retain the reticulum without distortion. Both show that the coarse meshes with strongly elevated spicular margins, such as characterize most other species of the genus, are continued from the lateral walls to the base, and while they present the same general aspect as do those of the upright surfaces of the sponge, their composition is distinctly different. There is no radial arrangement evident in these bands, no center of departure nor apex of attachment. The vertical bands from the lateral walls, bent abruptly into the diaphragm, cross each other from opposite sides, making, over the central portion of the base, large square meshes of the same aspect as those occuring elsewhere, but here formed only by the intersection of the vertical spicular bands.

The actual crossing of these vertical bands is restricted to the central area of the base; away from this area and in the peripheral region of the disk, the bands of both sets gradually put on the aspect of the horizontal bands of the cup and actually form such bands. There are but a few of these concentric ridges on the disk, not more than three or four of the first order, and the inner ones are somewhat squared to the quadrate form of the central area, so that the transition from the concentric to the vertical ridges

is barely noticeable on a cursory inspection. The character of this peculiar reticulation is such that four small wedge-shaped areas remain, one in each quadrant, where rectangular reticulation can not occur. These are at the sides of the broad bands of vertical spicules extending over from the lateral walls of the cup, and here the net-work is not only irregular but seems to have formed a node or tuft.

Beyond the edge of the basal plate extends a frill of considerable width, very similiar in character to that occurring in *Phragmodictya catilliformis*, but not as wide as has been observed in that species, and with a crenulated or deeply furrowed surface. At the union of the frill with the body of the sponge, low, irregular and elongate nodes are formed, as observed in other species of the genus. The more prominent of these extend outward from the periphery over the lower surface of the expansion and may become considerably elevated, with smooth, concave interspaces. The coarse reticulation of the skeleton is here visible only near the base of the frill, further outward the net-work being obscured. In the specimens under consideration the actual extent of the frill is pretty clearly defined by a discoloration of the matrix.

The strong, coarse net-work of the basal disk does not obscure the exceedingly fine ultimate reticulation which is everywhere seen. In one of the three specimens oblique compression has disturbed the regularity of the basal net-work, but the strong irregular nodes at the periphery are very pronounced. Confirmatory evidence of the view that these convex plates are basal and not apertural like the sieve-plate in EUPLECTELLA, is the following fact: The arenaceous slabs of the upper Devonian of western New York frequently have their surfaces covered with various forms of wave and ripple marks and furrows left by the dragging of pebbles, tracks of crustaceans, etc. Such surface markings were made on the soft muds which subsequently became shales, while the encroachment of more sandy sediments produced relief impressions of these configurations so that such reliefs are found upon the lower side of the sandy layers. One of these basal disks of *Thysanodictya hermenia* lies at the upper surface of such a sandy slab, its convex face downward, the compressed cup above, while the lower surface of the slab is covered with relief impressions of mechanical markings made upon the sediments immediately beneath.

Locality. In the upper beds of the Chemung group at Hinsdale, Cattaraugus county, N. Y. (Collection by E. B. HALL.)

THYSANODICTYA APLETA, sp. nov.

PLATE XXVI, FIG. 1; PLATE XXVII, FIG. 8.

This name is applied to incomplete examples indicating cups of great size with a very coarsely lamellose-reticulate surface. None of the observed specimens is sufficiently complete to give a clear conception of the form of the sponge or a decisive idea of the generic character of the species.

One of the largest individuals seen is that figured on Plate xxvi; this has a length of about 275 mm. and a greatest width of 220 mm. The drawing has been made from a plaster-cast of an external impression, which shows the curvature of the surface and probably gives an approximately correct idea of the diameter of the cup, but no accurate indication of its length. So far as the original form of the cup is here suggested, it does not widely differ from that of the known species of THYSANODICTYA. The character of the surface fortifies this resemblance. The principal spicular bands form strong, erect lamellae, nodose at their intersections, characters which indicate the surface structure in that genus. The primary quadrules are usually square and measure about 14 mm. on a side, though very variable both in form and size. The secondary bands are usually clearly defined in all external casts, and no internal cast has been observed showing the finer meshes of the reticulum. The surface shows no other ornamentation than that described.

Localities. The largest of the specimens of this species was found loose among the sandstones of the upper Chemung at Alfred, Allegany county, associated with *Spirifer disjunctus.* Others nearly as large have been obtained at Hinsdale, Cattaraugus county, and fragments at Scio and Ischua. Smaller fragments have been received from Nile and Wellsville, localities in Allegany county, and from Olean, Cattaraugus county.

THYSANODICTYA TURRICULA, sp. nov.

PLATE XXXVIII, FIGS. 5, 6.

This is the most slender and graceful of all the species of the genus. The sponge is small and either tapers or expands upward from a relatively broad base. The surface is cancelled into narrow, elongate meshes which grow shorter about the aperture. While these quadrules may belong to a minor series, yet they are predominant upon the surface to the obscuration of others. The periloph is quite broad. These characters are well shown in the two entire specimens figured, one of which has a length of 40 mm., a basal width of 12 mm. and an apertural width of 7 mm. The width of the basal expansion

is 4–5 mm. The other has a length of 42 mm., a basal width of 10 mm., across the periloph, 18 mm. and across the aperture, 15 mm.

The species is well characterized by its elongate form, small size and the nature of its quadration.

Locality. In the upper Chemung sandstones at Wellsville, N. Y. (Collection of E. B. HALL.)

ARYSTIDICTYA, gen. nov.

This genus comprises sponges which are cylindrical toward the base but expand upward to a broad, flaring aperture, the general form of the sponge being like that of LEBEDICTYA. The lower extremity is, however, abruptly truncated by a circular, transverse or slightly convex diaphragm as in THYSANODICTYA and PHRAGMODICTYA. No basal frill has been observed.

Surface smooth or with low, irregularly arranged nodes; more or less distinctly reticulate.

Apertural region with fine, branching channels running to the margin.

Type, *Arystidictya elegans*, sp. nov.

ARYSTIDICTYA ELEGANS, sp. nov.

PLATE XLI, FIG. 10; PLATE XLII, FIG. 7.

SPONGE of considerable size. The single specimen has been compressed but was undoubtedly circular at the base and regularly obconical for about one-third of its length, thence expanding abruptly to the very large aperture. The form of the cup is, thus, somewhat broadly vase-shaped.

Surface smooth, without nodes or other irregularities. Margin regular and entire.

The *reticulum* as preserved appears to be composed, over the lower part of the sponge, of rather sparse and loosely arranged spicular bands crossing at right angles and forming square meshes about 4 mm. on a side. Whatever subdivision of these meshes existed appears to have been quite irregular and the principal quadrules themselves seem to be at times crossed by deviating threads of the principal strands. Over the upper expanded surface of the cup the reticulation is not distinctly visible, the surface being smooth or covered with irregularly distributed depressions, and toward the aperture these are extended into grooves or branching channels, subparallel to one another and perpendicular to the margin.

The base of the sponge is truncated by a diaphragm the compression of which has obscured the reticulation of the surface.

Dimensions. Length 145 mm.; diameter at the base 53 mm., at the aperture, 160 mm.

Locality. In the lower part of the Chemung group at Cotton hill, one mile north of Avoca, Steuben county, N. Y. (Collection of E. B. HALL.)

ARYSTIDICTYA NODIFERA, sp. nov.

PLATE XLI, FIG. 11.

In this species the cup expands somewhat more regularly than in *A. elegans*, and is of smaller size. Its surface is covered with low, vertically elongate nodes which appear to be without definite order; these are larger toward the base and become small and obscure toward the aperture, the region about the apertural margin being smooth. This margin is smooth, uninterrupted, thin and regular.

This is an interesting species, but is unfortunately known only from a part of a cup representing probably about one-half the original width.

Locality. In the lower part of the Chemung group at Cotton hill, near Avoca, N. Y., associated with *A. elegans*, *Hydnoceras tuberosum*, *H. multinodosum*, *H. eutheles* and *Hallodictya Cottoniana*. (Collection of E. B. HALL.)

HYPHANTÆNIA, Vanuxem (*emendata*).

1842. *Uphantenia*, Vanuxem. Geology of New York; Rept. Third Dist., p. 184, fig. 50.

1863. *Uphantœnia*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist. pp. 84–87.

The remarkable bodies to which the term UPHANTÆNIA has been long applied, are very large, circular and shallow saucer-shaped cups, composed of two series of intersecting spicular straps, one radiating from a common center, the other concentric about the same point. The example which was described by VANUXEM under the name *Uphantenia Chemungensis* was a flattened quadrant, the original circular form of which was only inferential; but specimens of the species since found show the aperture of the cup to have been circular. In shape it appears to have been slightly elevated at the basal point, thence outward to have curved gently downward and then upward again toward the apertural margin. This at least is the form presented by what seem to be internal casts, from the sandstones of the Chemung group. The peculiar feature of this shape, however, is the upward or inward projection of the apex or base of the sponge. In the two specimens in which this part of the cup is

retained there is a small mass of sandy matrix adhering to the basal portion, though the remainder of the cup so far as retained is cleanly separated from the rock. From this it is perhaps to be inferred that the center was largely a tufted pompon of spicules whose structure is obscured by complication with the sediment.

It is possible that the normal form of the cup was the reverse of that we have suggested; instead of being saucer-shaped, it may have been broadly umbrella-shaped. This is, however, less in accordance with the form usually assumed by the palaeozoic Dictyosponges which have been described, but it is a shape occasionally reproduced among living hexactinellids. The material, however, representing the genus is insufficient for the determination of this point.

From the center or basal point radiates a series of flat, gradually widening ligulate bands, with elevated or thickened edges. These bands are approximately of equal size and are subequidistant, but a slight difference in the interval between them at their origin becomes greatly increased toward the margin. There is no evidence of more than a single series of these vertical or radial bands, all of them meeting at the center. They are crossed by continuous concentric bands of similar character, though with a less palpable thickening of the margins. These regularly increase in width as they recede from the center, and the diameter of the intervals between them also increases, but less rapidly. At their intersection with the radial bands they do not lose their definition, and are probably interwoven with them as there is no evidence of their displacement at these surfaces, as would in all probability have occasionally occurred had there been no actual connexion or interlacing of the spicules.

Over the interspaces between the radial bands it is observable that the position or angle of these concentric bands is slightly changed; they do not there conform to the general curvature of the surface of the cup but are horizontal or approximately so; the effect of this arrangement is to give to each of these radial interspaces including the bounding rays a suggestive resemblance to a much inclined step-ladder.

The meshes or quadrules produced by the intersection of the two series of bands usually show only clean rock surfaces; one specimen however indicates that these quadrules have had their angles filled by a delicate parenchymal film which encroaches on the quadrules to such an extent as to leave a subcircular opening. We have no palpable evidence of the nature of the spicules composing the radial or vertical, and the concentric or horizontal bands

Their surface is smooth and usually presents such an aspect as might be produced by the pressure of fine sand grains against a thin, flat body. It is so extremely seldom that any traces of the spicular skeleton are retained in the sandstones of the Chemung group, that the absence of such evidence here is not surprising. It is possible that their structure is similar to that of the ligulate spicules observed in *Dictyspongia Marcellia*. The character of the apertural margin is not shown in any of the specimens.

HYPHANTÆNIA seems to be a Dictyosponge in which the compacting and condensation of the vertical and horizontal spicular bands has been carried to an extreme, leaving between the sharply delimited bundles broad areoles which in generic types like HYDNOCERAS, DICTYOSPONGIA, etc., would be subdivided by the minor spicular bands, or in PHYSOSPONGIA, be filled by dermalia and parenchymalia.

The only known species of HYPHANTÆNIA is the *H. Chemungensis*, Vanuxem, and of this species but five specimens have come to our knowledge, four of them being here figured.

HYPHANTÆNIA CHEMUNGENSIS, Vanuxem.

PLATE XXVIII, FIG. 1, 2; PLATE XXIX, FIG. 1; PLATE XLV, FIG. 1.

1842. *Uphantenia Chemungensis*, Vanuxem. Geology of New York; Rept. Third Dist., p. 184, fig. 50.

1863. *Uphantænia Chemungensis*, Hall. Sixteenth Ann. Rept. N. Y. State Cab. Nat. Hist., pp. 84–87, figure (on p. 86).

1884. *Uphantænia Chemungensis*, Hall. Thirty-fifth Ann. Rept. N. Y. State Mus. Nat. Hist., p. 481.

1890. *Uphantænia Chemungensis*, Lesley. Dictionary of Fossils, vol. 3, p. 1246.

SPONGE large, explanate, broadly saucer-shaped, or umbrella-shaped with a short base of attachment. Apertural outline circular. The radiating ligulate spicular bands, all of which depart from the center or apex, number thirty-two in the two specimens which retain this part of the sponge; the original specimen which is approximately a quadrant of the cup indicates the existence of the same number of radial bands. These, as above observed, are not always equidistant, but the irregularities in this respect are not conspicuous. The concentric horizontal bands regularly increase in width from apex to margin. What their number was in the completed cup it is impossible to say; the greatest radius of the largest specimen shows

nineteen of these and the appearance of the outermost one indicates the margin of the cup.

There is some variation in the relative proportion of the parts shown in the material at hand. The greatest radius exposed by any specimen is 192 mm.; upon this are nineteen concentric bands; upon the original specimen a radius (almost but not quite complete) of 147 mm. shows twenty concentric bands. In another example there are fourteen bands in a radius of 100 mm. There is no regular variation in size in either series of bands, but sometimes there is a slight change in the width of a concentric band; as, for example, the 15th concentric band on the original specimen measures 5 mm. at one place, and 8 mm. at another. In three of the specimens the 13th concentric band is situated at a radial distance, measuring its outer edge, of 93 mm., 92 mm. and 118 mm. In the first of these the width of this band is 4.5 mm.; in the second 3.2 mm.; in the third 5 mm. These differences are undoubtedly individual variations.

The largest example of this sponge yet observed has a greatest diameter of 347 mm.; its radius, which appears to be complete, is 192 mm. so that its full diameter was about 380 mm. or 15 inches. A smaller individual not complete at the margin has a diameter of 170 mm.

Geological horizon. In a compact and fine-grained greenish or rusty sandstone from the upper beds of the Chemung group, in the vicinity of Owego, Tioga county, N. Y. Upon one of the specimens are crinoidal segments and abundant examples of *Tentaculites spiculus*.

HALLODICTYA*, gen. nov.

SPONGE growing in an explanate frond without definite limitation of its margins; in this respect similar to the genera ACTINODICTYA and CRYPTODICTYA. Surface highly irregular, moulded into circular or elongate nodes irregularly grouped, and broader swellings and depressions. Reticulation of the surface fine, regular and rectangularly developed.

Type, *Hallodictya Sciensis*, sp. nov.

HALLODICTYA SCIENSIS, sp. nov.

PLATE XXXVI, FIG. 8.

This very interesting sponge is of considerable size, showing that its explanate mode of growth was maintained in all stages. Its surface is of so

* This generic term is intended as a partial, though inadequate recognition of the important contributions to the knowledge of the Dictyosponges of the Chemung group made by E. B. HALL, Esq., of Wellsville, N. Y.

irregular a character as to convey the impression that the frond might have conformed its shape to the irregularities of the surface upon which it grew. Yet our knowledge of the mode of growth in living siliceous sponges does not favor this conception; rather, that the frond was attached at one extremity, its expanded surface free and, consequently, its irregularities not due to such conformation, but altogether idiocratic. These irregularities may be roughly classed as great and small. The former are the main depressions and elevations of the frond; the latter are groups of nodes or pits upon the surface of the former, which are probably of similar nature to the tufted node of HYDNOCERAS and other genera. On the exposed surface of the specimen in hand, these nodes are expressed as pits generally narrow and elongate rather than circular, and seldom occurring singly.

The *reticulum* is fine and sharp but shows only the ultimate and penultimate quadrulation, spicular bands of higher order being wholly obscured. The direction of the spicular lines indicates no convergence to any single point; those of the horizontal series curve as the contour of the surface requires, and seem to approximate a circular curvature in both the upper and lower portion of the specimen. The upper area is the better defined, and near the center of the general curvature of the spicular bands is the best defined group of small nodes upon the surface. We may thus infer a remote possibility of the attachment of the frond at more than one point, whence the growth of the spicular skeleton progressed.

This species has been observed in but a single specimen having a length of 190 mm. and a greatest width near the middle of 90 mm.

The interpretation of the obscure genus CRYPTODICTYA, as well as ACTINODICTYA, is made clearer by the aid of HALLODICTYA. In ACTINODICTYA, the evidence of spicular reticulation is restricted to coarse, ridge-like bands which, though seeming to make, at times, quadrangular meshes, usually appear to be without much order, so that, by itself considered, there might be a possibility of misconstruction in regarding them as representing the actual meshwork of the sponge. In CRYPTODICTYA, this condition is the more obscured by the actual obliteration of nearly every trace of the spicular skeleton except the tufts at the tips of the nodes. In this genus, however, the surface nodes are quite as strongly developed as in HALLODICTYA. All three genera agree in their explanate, irregular and undefined mode of growth.

Locality. *Hallodictya Sciensis* occurs in a compact siliceous sandstone at Scio, Allegany county. (Collection of E. B. HALL.)

HALLODICTYA COTTONIANA, sp. nov.

PLATE XLI, FIG. 12.

A portion of a frond, evidently of the mode of growth characterizing this genus, is less irregular than the foregoing species in the nodulation of its surface, which bears only low and inconspicuous elevations. The reticulation is quite as sharply defined as in *H. Sciensis*, but it is notably less regular and lacks even the suggestion of arrangement about any point. Notwithstanding this irregularity, the impression of the reticulum clearly pertains to one and the same layer, there being no evidence that such irregularity is due in any way to the overlapping and compression of the reticular walls.

The single specimen observed is of small size, measuring 85 by 50 mm., evidently not the entire extent of the frond.

Locality. In the middle beds of the Chemung group, at Cotton hill, one mile north of Avoca, associated with *Hydnoceras multinodosum*, *Arystidictya elegans* and *A. nodifera*. (Collected by JACOB VAN DELOO.)

ACTINODICTYA, Hall.

1890. *Actinodictya*, Hall. Ninth Ann. Rept. N. Y. State Geol., p. 59; Forty-third Ann. Rept. N. Y. State Museum, p. 261.

This genus was constituted for explanate, somewhat irregularly growing sponges, whose surface is depressed convex and whose form appears, from the aspect of the majority of specimens, to have been broadly oval. The fronds have not shown the mode of attachment, but the absence of any cicatrix, or stem, may perhaps indicate that the sponge was fixed by a marginal foot-stalk. There are among the living hexactinellids species having this explanate or leaf-shaped aspect and attached by such a stalk-like basal extension; and these bodies may be compared with the *Euryplegma auriculare* as figured by SCHULZE (Voyage of H. M. S. "Challenger"; Hexactinellida, pl. cii, fig. 1). The surface of the specimens is crossed in all directions by ridges and lines of various sizes representing the interlacing spicular bands, and yet, notwithstanding the conspicuous irregularity in the disposition of these bands, every specimen shows more or less distinctly a certain degree of rectangular reticulation among both the coarser and finer bands. The coarse bands are comparatively few in number, and the differences in size in the coarse and fine ridges are gradational and never abrupt. The irregular intersection of the various spicular bands gives the reticulum a somewhat stellate aspect.

In the living species, *Walteria Flemmingi*, Schulze (see work cited, pl. ix),

there is a very similar irregularity in the sponge meshes produced by the intersection of spicular bands at various angles, while the rectangular intersection is to some degree retained. Though WALTERIA is a cup-shaped sponge, the structure of its reticulum indicates that these fossil bodies, ACTINODICTYA, are correctly construed as hexactinellid sponges.

Type, *Actinodictya placenta*, Hall.

ACTINODICTYA PLACENTA, Hall.

PLATE XXX, FIGS. 1-3; PLATE XXXI, FIGS. 1, 2.

1890. *Actinodictya placenta*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 60; Forty-third Ann. Rept. N. Y. State Museum, p. 262.

SPONGE explanate, broadly depressed-convex, most of the specimens having a suboval though unfinished outline, occasionally with margins deflected or incurved. Surface without nodes but covered with spicular ridges of various sizes, the larger usually crossing the frond through its entire length, the smaller being traceable for a less distance; these ridges crossing one another in all directions without obscuring a certain degree of rectangular reticulation. The margins of the specimens are not defined by any of the spicular bands. The variation in size from the coarsest to the finest bands is very considerable. The surface of these fronds is usually of a darker color than the matrix, and this fact contributes to the actual appearance of the specimen in evincing the very close interweaving of the spicular bands.

Localities. This species has proven to be quite abundant in some of the lower or middle strata of the Chemung group in the vicinity of, and to some extent in association with the colony of *Hydnoceras tuberosum* at the Brown hill school house near Wallace, Steuben county. A few specimens have come from this spot itself, and about a half-mile away, upon the farm of Mr. JOHN ROTH, a considerable number of fine specimens has been collected by Mr. JACOB VAN DELOO, in close proximity to the horizon of *H. tuberosum*. A few miles to the southeast, in the town of Howard, Mr. D. D. LUTHER has found some loose arenaceous slabs undoubtedly derived from the immediate neighborhood, and which are nearly composed of small fronds of this sponge. Among the earliest specimens of the species found are some from the upper Chemung beds near Lawrenceville, Tioga county, Pennsylvania, collected in 1879, by A. S. SHERWOOD. Associated with it in the localities in Steuben county are *Atrypa hystrix*, *Spirifer mesacostalis*, *Productella lachrymosa*, and *Poteriocrinus Clarkei*.

CRYPTODICTYA, Hall.

1890. *Cryptodictya*, Hall. Ninth Ann. Rept. N. Y. State Geologist, p. 60; Forty-third Ann. Rept. N. Y. State Museum, p. 262.

Irregularly growing, tuberose, coarsely nodose, and probably uninclosed sponges, with a surface showing no reticulating spicular bands; the skeleton being presumably composed of extremely fine isolated spicules, except at the summits of the nodes which show evidence of short tufts of prostalia.

Athough these specimens do not, of themselves, clearly demonstrate their title to a position among the hexactinellid sponges, yet in the light of the associated generic structures, HALLODICTYA and ACTINODICTYA, we are doubtless justified in regarding them as SILICEA, having a matted or felted reticulum of very minute spicules, and nodes with distinct prostalia developed at their summit.

In addition to this structure, the surface frequently presents a sort of linear striation or brush of lines departing from the nodes or sweeping irregularly over the concave spaces.

Type, *Cryptodictya Alleni*, Hall.

CRYPTODICTYA ALLENI, Hall.

PLATE XXXI, FIGS. 3-5; PLATE XXXII, FIGS. 1-4.

1890. *Cryptodictya Alleni*, Hall. Ninth Ann. Rept. N. Y. State Geol., p. 60; Forty-third Ann. Rept. N. Y. State Museum, p. 262.

SPONGES of moderately large size, with a general tendency to a suboval or elongate outline, and a depressed convex surface with abruptly deflected margins. In the majority of the best preserved examples this margin is clearly defined for more or less of its extent, showing that the form was frond-shaped or scaphate, though highly irregular and tuberose in contour and variable in outline. In one example the frond has been so enfolded by lateral compression as to bring the edges close together and produce the appearance of a nearly closed cup. The attachment of these bodies must have been either by means of a foot-stalk or by the margins of the frond. The nodes upon the surface are of various shapes and irregular in disposition; usually a number of small nodes are situated upon the summit of a large one, these being connected by a more or less sharply defined ridge, an arrangement also seen in the genus HALLODICTYA. The entire surface of the rock covered by the frond is invariably tinted of a deep chocolate or reddish brown, in strong contrast to the color of the matrix. An obscure, irregular lineation of

the surface can be made out on nearly all examples, but it is not such as to give a clew to the skeletal structure, except as we may infer that the skeleton was fine and dense, and we know that the nodes were tufted.

A symmetrical individual of suboval outline has a length of 155 mm. and a median diameter of 90 mm.; this is about the average size of most of the specimens.

Geological horizon. In the Chemung sandstones near Cohocton and Avoca, Steuben county, and at Lyndon, Cattaraugus county, N. Y. Named for the late Reverend JONATHAN ALLEN, former President of Alfred University, Alfred, N. Y.

AGLITHODICTYA, gen. nov.

Small, button-shaped sponges, greatly expanded horizontally at mid-length, abruptly tapering to both extremities. Aperture narrow; surface finely reticulate, without nodes or other ornament.

Type, *Aglithodictya numulina*, sp. nov.

AGLITHODICTYA NUMULINA, sp. nov.

PLATE XXV, FIGS 6–9.

SPONGE small, subdiscoidal, biconvex with reference to a median horizontal plane, the parts below and above this plane being subconical, that above being considerably the more depressed. Radical portion of the cup not fully retained; lateral expansion from the inferior extremity about thrice the vertical growth. The sponge attains its greatest diameter at a horizontal plane lying about three-fourths of the vertical distance from the inferior extremity to the aperture, and is thence bent sharply upwards. Upon the matrix there is some trace of an erect spicular lamella or expansion about the cup at this plane; otherwise the surface is smooth. The margin of the apertural orifice is rounded and somewhat swollen into low irregular nodes. Departing from the orifice and traversing the apertural slope to the peripheral angulation are traces of divergent surface grooves or canals such as are frequent among the lithistid sponges and are not unknown among the thick-walled hexactinellids.

The *reticulum* is exceedingly fine, but distinguishable over all of the principal exposures of the surface. There is no noticeable predominance of any spicular bands, and the quadrules are rather too indistinct to be accurately measured. The species is based on a single fairly preserved specimen in a sandstone matrix; the form is well retained and the skeleton in the usual condition of other sponges of this fauna. This specimen has a vertical length of 11 mm., a greatest diameter of 24 mm., and an apertural width of 8 mm.

Observations. It may be possible that in this species we have not a true thin-walled Dictyosponge, as its form, relatively small aperture, and the radial canals upon its surface all suggest some of the thicker-walled sponges, such for example, as those of the genus PACHYTRICHISMA, one of the dictyonine family, VENTRICULITIDÆ. (For comparison see ZITTEL, *Handbuch der Palaeontologie*, vol. 1, p. 177, *P. Carteri*, Zittel, fig. 92.) Nevertheless, such positive evidence as here presented, affords no good reason for excluding this peculiar genus, AGLITHODICTYA, from the DICTYOSPONGIDÆ.

Locality. In the sandstones of the Chemung group, near Lawrenceville, Tioga county, Pennsylvania.

SPECIES FROM THE PSAMMITES DU CONDROZ (FRANCE).

Submitted by Professor CHARLES BARROIS, University of Lille.

DICTYOSPONGIA MORINI, Barrois (sp.).

PLATE XLVI, FIGS. 1, 2.

1883. *Dictyophyton Morini*, Barrois. Annales de la Soc. Géol. du Nord, vol. xi, p. 83, pl. 1, figs. 2 a–c.

This species is one of the smooth conical sponges for which the generic term DICTYOSPONGIA has been here proposed. The specimen which we have examined represents the upper portion of the cup including the aperture, which is regular and apparently unornamented. The impression of the reticulum is obscurely retained and extremely fine. Professor BARROIS has figured not only the specimen here illustrated, but also one which retains the basal part of the cup and shows that the expansion of the sponge was gradual and uniform.

Locality. Jeumont (Departement du Nord), Brittany.

HYDNOCERAS BARROISI, nom. nov.

PLATE XLVI, FIGS. 3, 4.

1883. *Dictyophyton tuberosum*, Barrois. Annales de la Soc. Géol. du Nord, vol. xi, p. 82, pl. 1, figs. 1 a–e.

Attention has already been directed to the fact that the species described as *Dictyophyton tuberosum*, Conrad, by Professor BARROIS, in his memoir on the DICTYOSPONGIDÆ of the Psammites du Condroz, proves, after a careful revision and comparison of the nodose sponges, to represent a specific form which is not, to our knowledge reproduced among the American species of this genus. The distinctive characters of the French fossil lie in (1) the very deep and broad horizontal constrictions which render the node-bearing ridges very conspicuous; (2) the sharply defined prism-faces, their margins being distinctly continuous ridges extending from the apex and crossing the horizontal constrictions; (3) a faint median ridge dividing each of the eight prism-faces; (4) the low, elongate and sharp nodes forming ridges by fusion with the vertical prism-margins. The single specimen is broken across the third node-bearing ridge and there is, hence, no means of inferring the number of such

horizontal ridges in the total length of the sponge. There is still another feature in which this species differs from *H. tuberosum*, viz.; (5) the prevalence of a very fine network, the meshes being of subequal size, contracting over the constricted areas. Large quadrules such as are usually found in *H. tuberosum* are wanting. Professor BARROIS's excellent figures of this species show the curvature of the sponge, which seems to be probably an accidental feature of the specimen.

Locality. In compact greenish sandstone of the Psammites du Condroz (=Chemung group of New York), Jeumont, Brittany.

HYDNOCERAS JEUMONTENSE, sp. nov.

PLATE XLVI, FIGS. 5, 6.

This form is represented by several more or less compressed specimens in which the cup is broad and has somewhat the aspect of the Chemung species, *H. phymatodes*, though with coarser, less abundant and less regular nodes.

The form of sponge is rather broadly turbinate, its lower portion being distinctly prismatic for a considerable distance from the apex. The horizontal constrictions appear to be rather narrow and shallow, while the node-bearing ridges are decidedly elevated and often quite broad. The nodes themselves are elongate and those of the vertical rows are more or less distinctly connected by the ridge at the angle of the prism-faces. A remarkable character of the species is the rapid multiplication of nodes. At the base of the sponge the number of the prism-faces appears to be, as normally, eight, but even on the first node-bearing row, nodes may appear on the interspaces between the angles of the prism and as many as twelve nodes may be counted upon the second row in one of the specimens. The increase by intercalation is not, however, always so rapid, as another example shows nine, with an incipient tenth, in the second row. The nodes also multiply in another manner, namely by the transverse division of a single node into two, or to express the fact with greater accuracy, the appearance of two nodes one above the other in the place usually occupied by one. This is seen on the specimens figured, while another example not here illustrated shows the duplication of all the nodes of one row, thus making a complete double row of nodes. This interesting mode of duplication of the nodes has not been observed in any American species, but seems to indicate an approximation to the condition attained in the genus BOTRYODICTYA.

The *reticulum* is very fine, as in *H. Barroisi*, showing none of the coarser meshes prevailing in the Chemung species of this genus. None of the specimens are so preserved as to show tufts at the end of the nodes.

Dimensions. The most complete individual, which bears three horizontal rows of nodes and a considerable portion of an anodose base, has a length of 155 mm. and a width across the top (exaggerated by compression) of 100 mm.

Locality. In the Psammites du Condroz, Jeumont, Brittany.

RHABDOSISPONGIA CONDROZIANA, sp. nov.

PLATE XLVII, FIGS. 1, 2.

This magnificient species shows some of the exterior characters of the Chemung form, *Dictyophyton Amalthea*, which has elsewhere been taken as the type of the proposed genus RHABDOSISPONGIA. These are, briefly, the successive annulations, separated by deep constrictions and crossed by vertical or divergent ridges.

In the French specimens the apical portion of the cup is regular and without annulations for a considerable distance, the surface here being divided into eight prism-faces. In the best preserved example the first annulation is, on one side, an enormous bulging of the cup, which covers more than one-half the length of the specimen and makes its greatest width. On the other side, this large swelling is divided into two, by a broad constriction near its lower portion, which extends rather more than half-way around the cup. This forms a small annulation beneath and a large one above. The constriction above this double annulation encircles the entire cup, but the succeeding swelling is of less size and is apparently of equal width on both sides of the sponge. Above this is evidence of a still fainter constriction and annulation, making in all four annulations on the best preserved side. There are three specimens of this species in the material at hand, and all of them show the tendency to develop an annulation or swelling on one side earlier than on the other. To this fact are due the slight curvature and lateral asymmetry of the sponge. The eight vertical ridges near the base of the cup maintain themselves over the entire extent of the sponge, diverging greatly as they pass over the expanded portions. Their number is increased by the gradual appearance of new ones at the center of the faces, but the latter are never so strong as the primary ridges.

The *reticulum* is fine-meshed throughout, as in the other species from this horizon.

Dimensions. The largest and best preserved of the three specimens had a length of 300 mm., which must be considerably less than its original length, as parts are lacking at both extremities. Its width at the base is 50 mm., across the first annulation 115 mm., and at the top 100 mm.

Locality. In the Psammites du Condroz, Jeumont, Brittany.

EXPLANATIONS OF PLATES.

PLATE I.

CYATHODICTYA, nom. propos.

Page 764.

CYATHODICTYA RETICULATA, Walcott (sp.).

Page 764.

Figures 1–6. A series of young specimens, all of natural size, showing gradation in form, and most of them retaining the reticulum more or less completely.

Figure 7. An unusually large example, its spicular structure somewhat conventionally reconstructed in places, showing the arrangement of the spicular elements and, beneath the reticulum, the irregularly distributed areoles outlined in an unresolvable mass of pyrite.

Figure 8. The apertural portion of an average cup, torn at one side; enlarged to show the finer spicular net-work about the margin. x 3.

Figure 9. An individual of somewhat less than average size.

Figures 10, 11. The apertural extremities of two individuals. The apparent thickness of the spicular wall is due to slight incurvature about the aperture. x 3.

Figure 12. The basal extremity of an average specimen; showing the extension of the reticulum into a short basal tuft. x 3.

Figure 13. An enlargement of a portion of the reticulum, showing the different series of simple cruciform spicules, and the underlying layer with its areoles. This inner layer is unresolvable, its substance as preserved being granular pyrite. It will be observed that the areoles are irregularly disposed and are covered by spicules of the outer frame-work. x 5.

Utica slate. *Holland Patent, New York.*

SPHÆRODICTYA, gen. nov.

Page 766.

SPHÆRODICTYA SUBSPHÆRICA, Walcott (sp.).

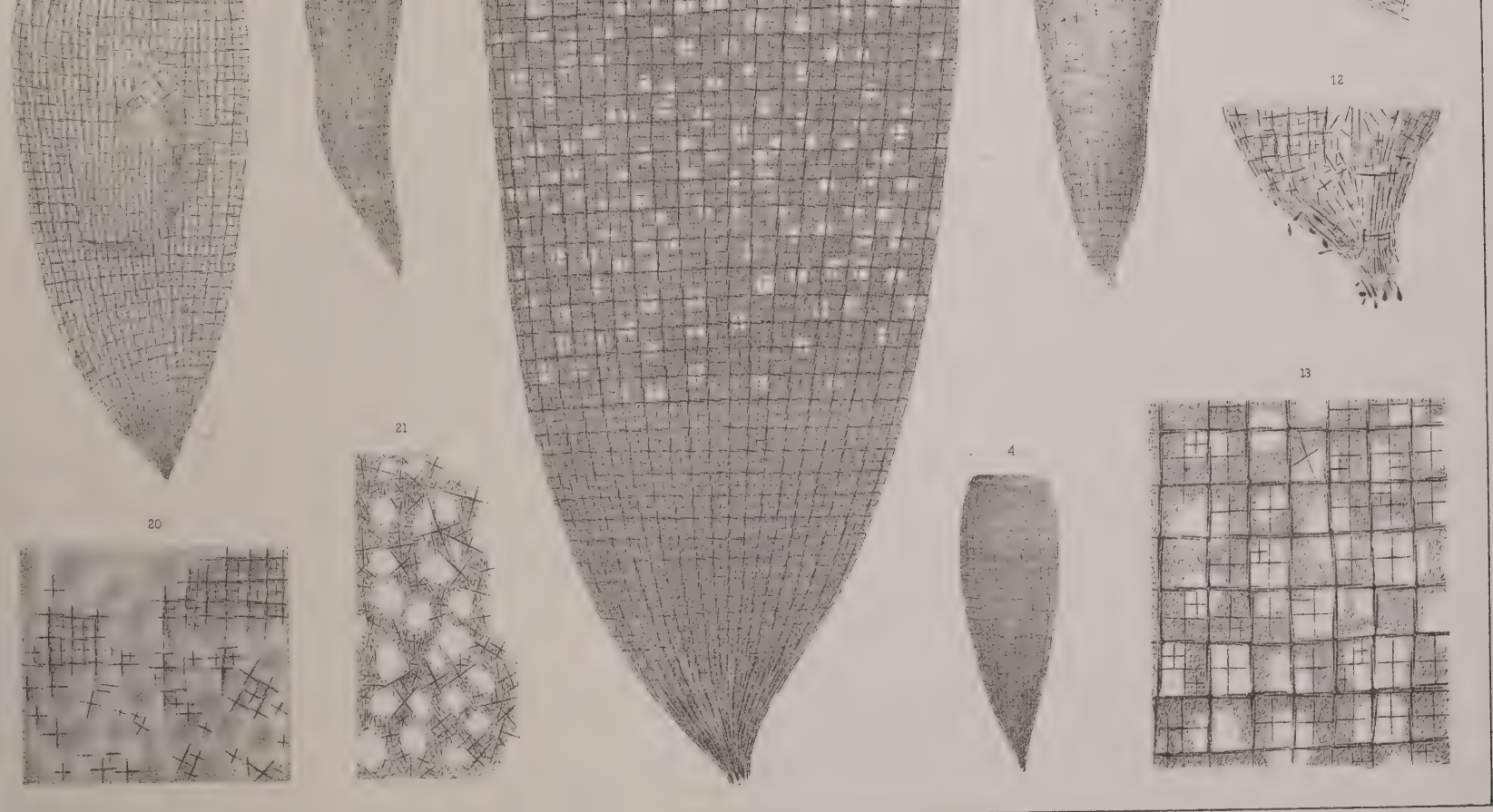
Page 766.

Figure 14. A cluster of young individuals of various sizes, showing peripheral spicules on some of the specimens.

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate I.



G.B. Simpson del.

Wynkoop, Hallenbeck, Crawford Co., State Printers, New York and Albany.

Figure 15. One of the two largest of the specimens in this group, enlarged; showing the peripheral spicules, and the cruciform spicules over a part of the wall. The surface is a continuous pyrite film with an irregular break near the center, due to the adhesion of a part of the film to the opposite side of the matrix. The specimen from which these two drawings have been made was loaned for the purpose by the U. S. National Museum and is one of the specimens upon which RAUFF based his conception of the genus TEGANIUM. x 3.

Figure 16. Another group of young examples.

Figure 17. One of these enlarged, showing long peripheral spicules and a continuous surface film. x 3.

Figure 18. A normal mature specimen, natural size. This specimen is in the condition of preservation usual for this species, the sponge having separated in such a manner as to expose the inner poriferous wall of the reticulum, and the outer wall in peripheral section. The rest of the latter adheres to the separated portion of the matrix.

Figure 19. An enlargement of a portion of the inner wall, showing the areoles enclosed by a net-work of irregularly arranged cruciform spicules. x 3.

Figure 20. A portion of the outer wall of the sponge, showing a regular reticulation, the matrix beneath bearing obscure traces of the areoles of the inner layer. x 3.

Figure 21. An enlargement of a portion of the surface similar to that shown in figure 19. x 3.

Figure 22. Part of a segment of one of these spheres, showing a portion of the inner wall, and the section of the outer wall. x 3.

All the specimens here figured are from the Utica slate at *Holland Patent, New York.*

PLATE II.

HYDNOCERAS, Conrad.

Page 835.

(See Plates III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS AVOCA, sp. nov.

Page 843.

(See Plates IX, X, XI.)

Figure 1. The upper portion of a large individual, an internal cast with very sharply defined reticulation; showing the broad, subcircular outline of the nodes.

Chemung group. *Avoca, New York.*

Figure 3. An incomplete and slender specimen with four horizontal rows of nodes, three of these being greatly extended.

Chemung group. *Jenks quarry, Bath, New York.*

HYDNOCERAS NODOSUM, Hall (sp.).

Page 849.

Figure 2. A view of a gutta-percha squeeze of the original impression; showing the small size of the species and its prominent nodes in at least five rows.

Chemung group. *Cattaraugus county, New York.*

HYDNOCERAS BOTRŒDEMA, sp. nov.

Page 842.

Figure 4. A specimen of average size, showing the extended, flattened and slightly drooping nodes, completely circular body and fine reticulation. This species is almost invariably found in a highly imperfect condition, and consequently, in this drawing the tips of the nodes have been somewhat restored from data furnished by several specimens.

Chemung group. *Irish hill, near Bath, New York.*

HYDNOCERAS TUBEROSUM, Conrad.

Page 837.

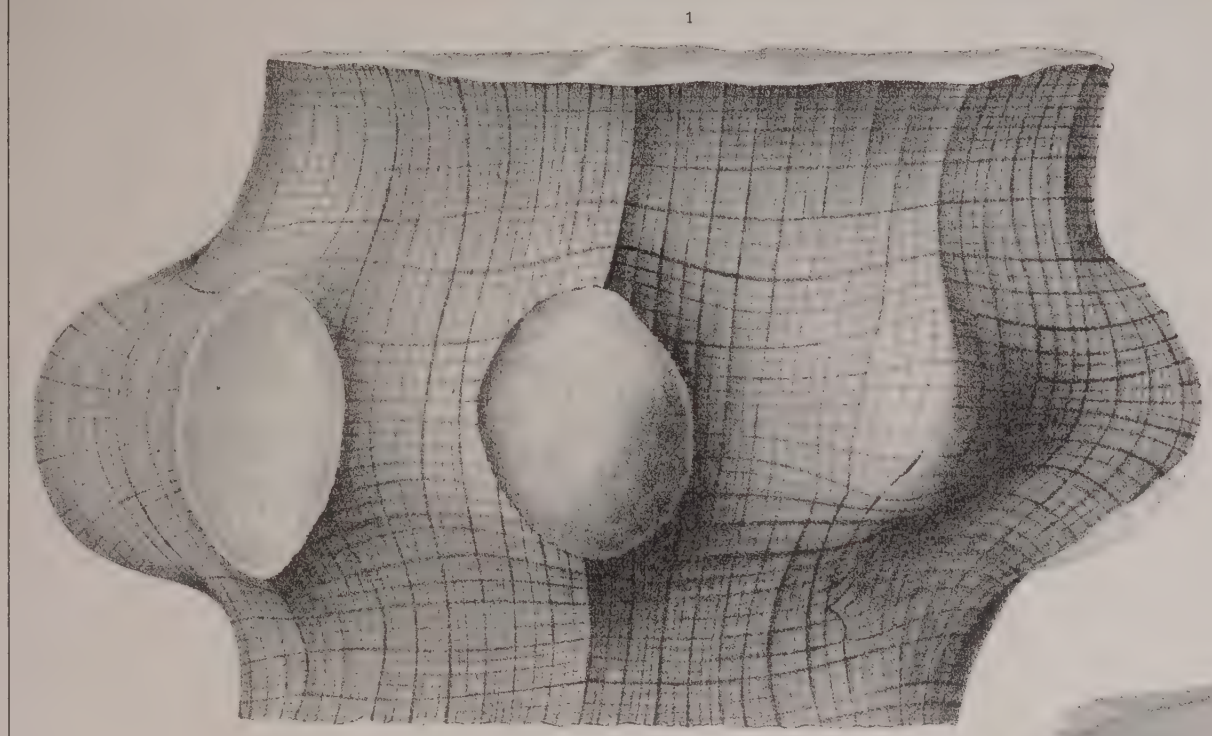
(See Plates III, IV, V, VI, VII, VIII, XXXVIII.)

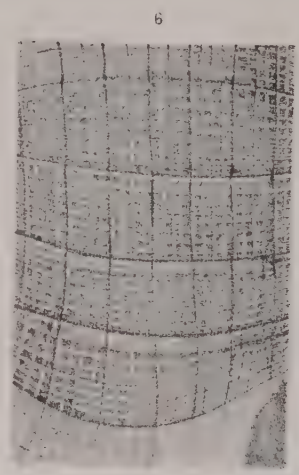
Figure 5. View from the upper end of an average internal cast.

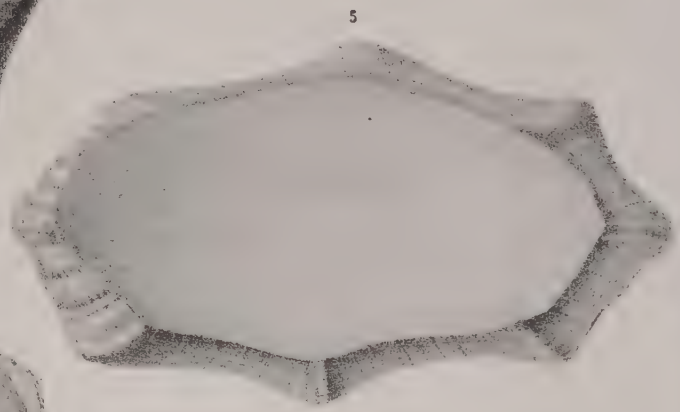
Figure 6. An enlargement of the surface of the internal cast.

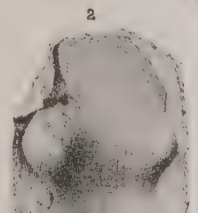
Chemung group. *Brown hill, near Cohocton, New York.*

DICTYOSPONGIDÆ.









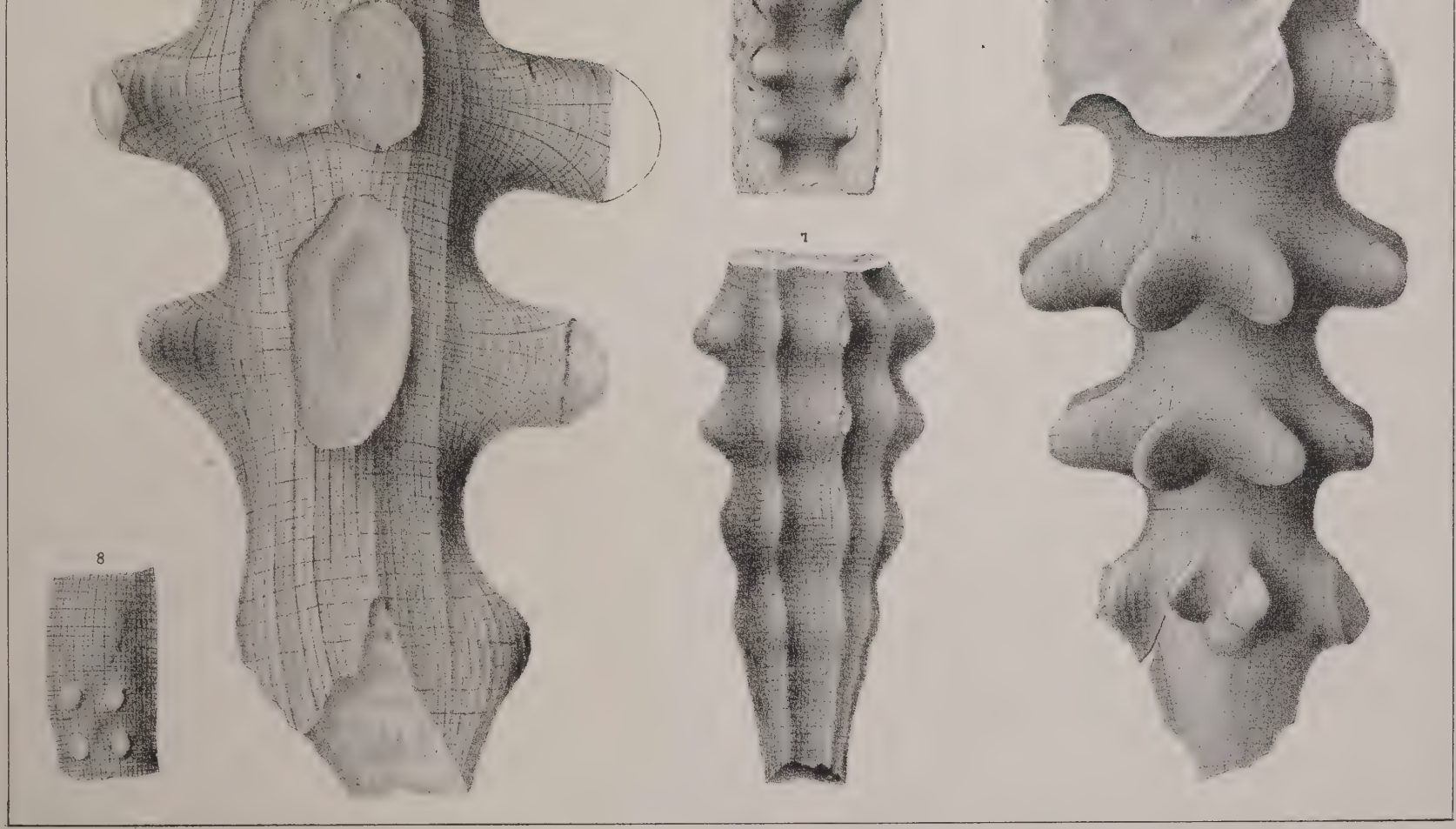


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Figure 7. A somewhat restored and conventional figure of this species, reproduced from the Thirty-fifth Annual Report of the N. Y. State Museum, pl. 17 (18), fig. 7.

HYDNOCERAS ANTHRACIS, sp. nov.

Page 849.

(See Plates VI and XXXIII.)

Figure 8. A fragment showing the upper portion of a small individual with fine reticulation, broad apertural surface and four low subcircular nodes.

Chemung group. *Wellsville, New York.*

PLATE III.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS TUBEROSUM, Conrad.

Page 837.

(See Plates II, IV, V, VI, VII, VIII, XXXVIII.)

Figure 1. The lower portion of a rather large individual in which the first horizontal row of nodes has developed with regularity, but the second and third rows have been disordered by the appearance of three nodes out of their normal position. It will be observed that owing to this malformation and a defect in the net-work near the center of the specimen, the vertical strands at the left of the drawing become continuous with and form the horizontal strands on the more remote node, lying next to the uppermost one on that side. This peculiar structure is very clearly shown on the specimen.

Figure 2. An incomplete specimen which has been somewhat compressed vertically and the depth of the horizontal constrictions thereby increased. The nodes have here, also, been somewhat irregular in their appearance, one in the third row occurring out of its vertical position, and its representative in the fourth row being omitted.

Figure 4. End view of a large specimen having but seven nodes.
Chemung group. *Brown hill, near Cohocton, New York.*

HYDNOCERAS BATHENSE, sp. nov.

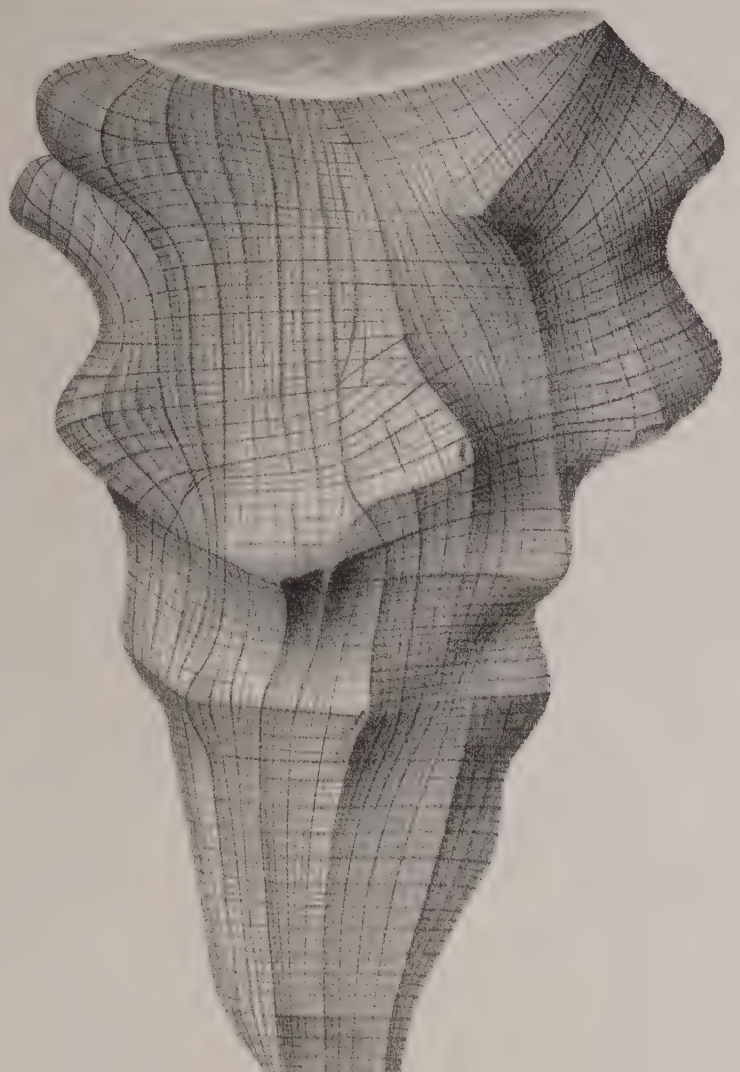
Page 841.

(See Plates VIII and IX.)

Figure 3. An incomplete individual of average size, showing the prominent nodes.
Chemung group. *Jenks quarry, Bath, New York.*

DICTYOSPONGIDÆ.

1



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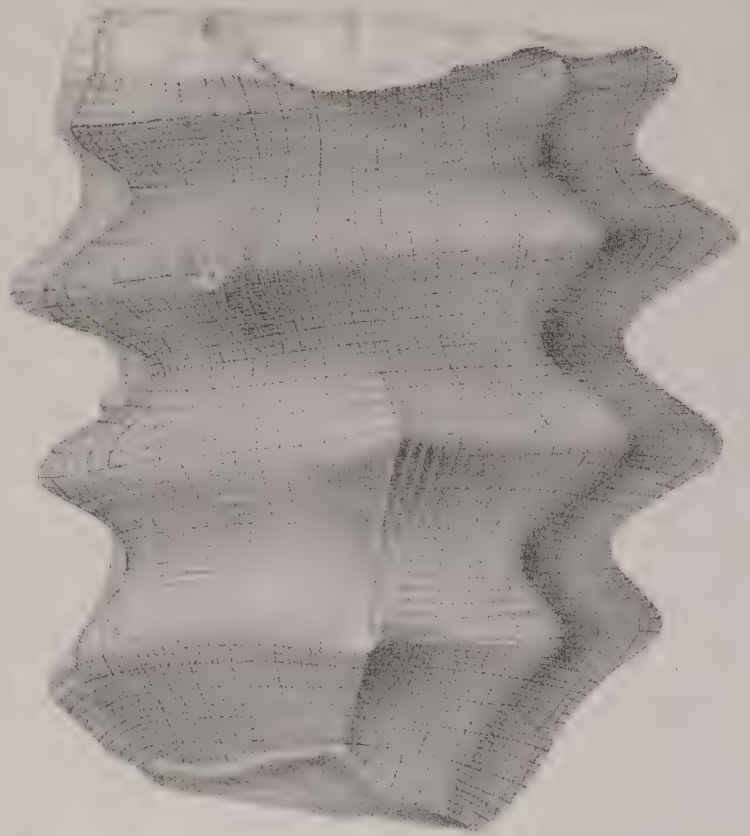

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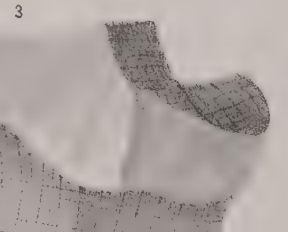

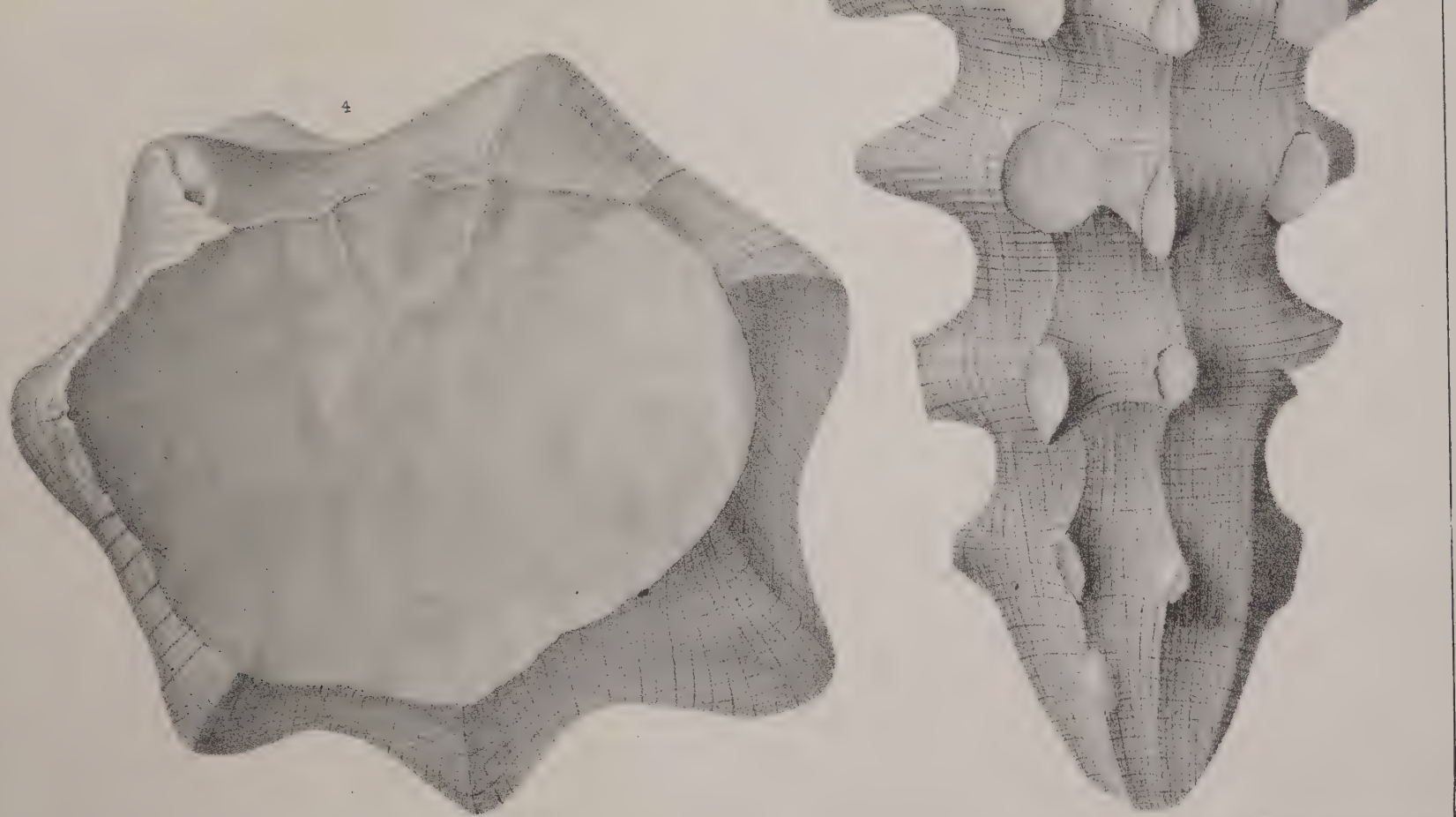

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PLATE IV.

HYDRIODICTYA, gen. nov.

Page 817.

(See Plates V, XVI, XXI.)

HYDRIODICTYA PATULA, Hall (sp.).

Page 818.

Figure 1. A view of the original specimen; showing the smooth, expanding surface, regular aperture and sharply defined reticulation.
Chemung group. *Brown hill, near Cohocton, N. Y.*

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI)

HYDNOCERAS TUBEROSUM, Conrad.

Page 837.

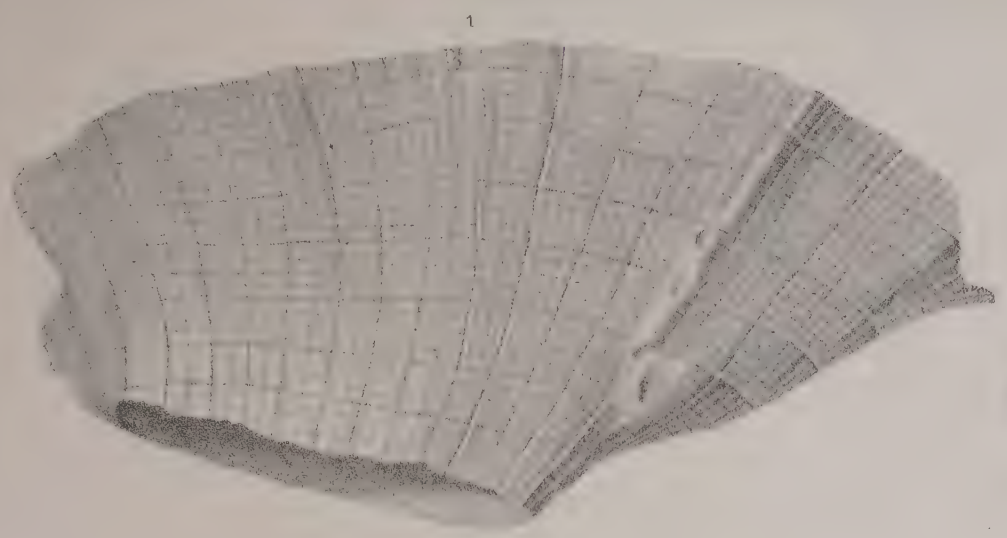
(See Plates II, III, V, VI, VII, VIII, XXXVIII.)

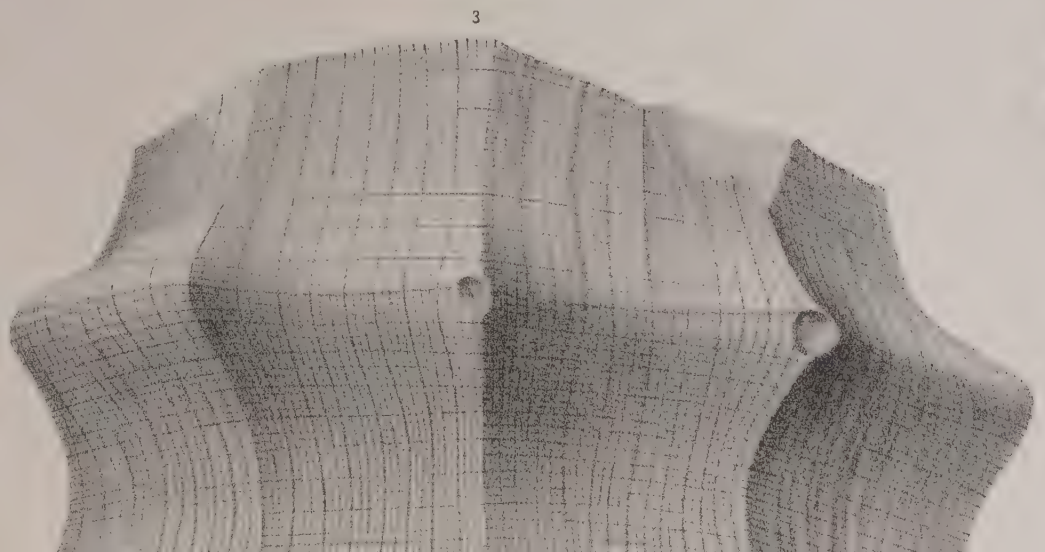
Figure 2. A plaster-cast of the original specimen of the species.
Chemung group. Said to have come from near *Addison, Steuben county, New York.*

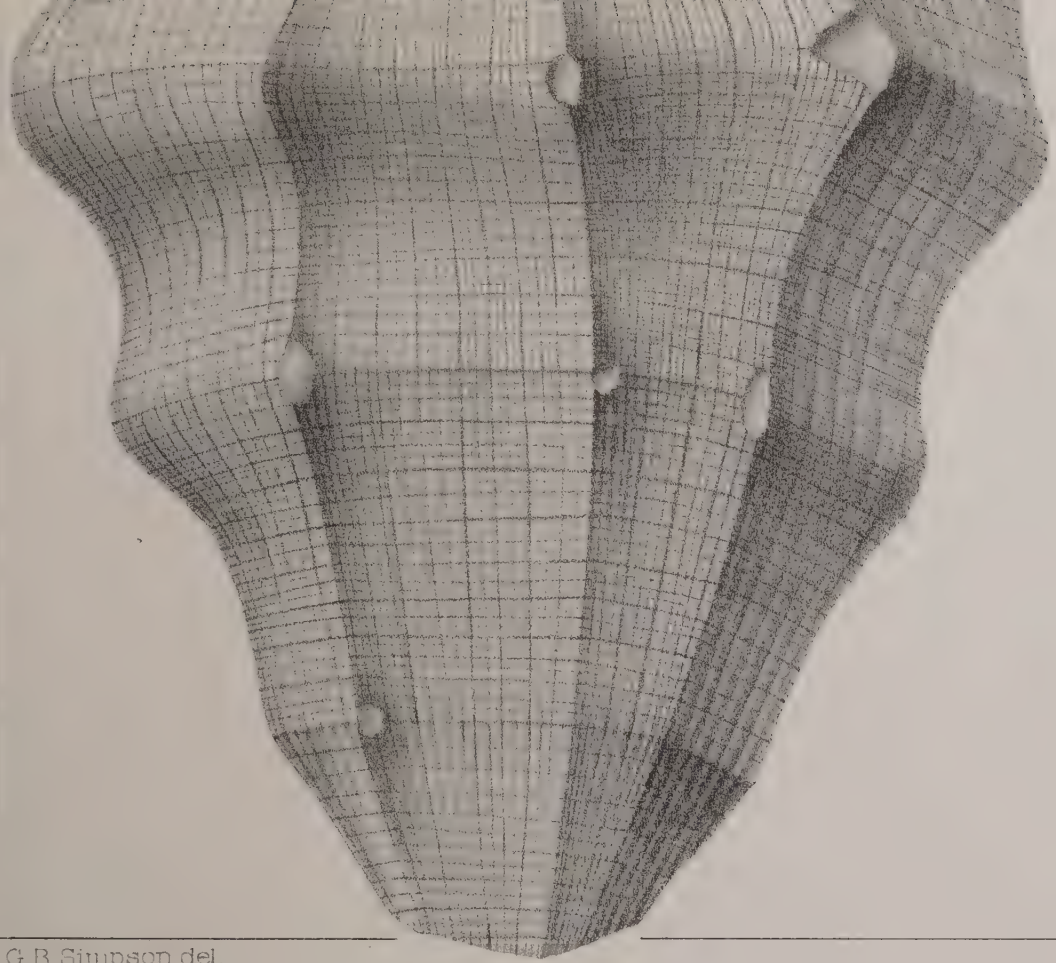
Figure 3. A very broad and somewhat compressed example with the reticulation and subprismatic form finely preserved.

Figure 4. A small specimen with the normal number of four horizontal rows of low nodes, the summit of each of which is incomplete, indicating the presence of spicular tufts at these points. The specimen lies in its matrix, which retains the impressions of the pointed tufts on the lateral nodes and the vertical, erect expansions connecting them. These were probably also present in varying degrees of development on all of the principal vertical and horizontal spicular bands. An interesting abnormality is shown on the lower right margin of the specimen where a very strong spicular tuft exists between two nodes in their normal position, and there is only very obscure evidence of an intercalary node at this point. The tuft near the base of the sponge represents another very faintly developed node.
Chemung group. *Brown hill, near Cohocton, New York.*

DICTYOSPONGIDÆ.







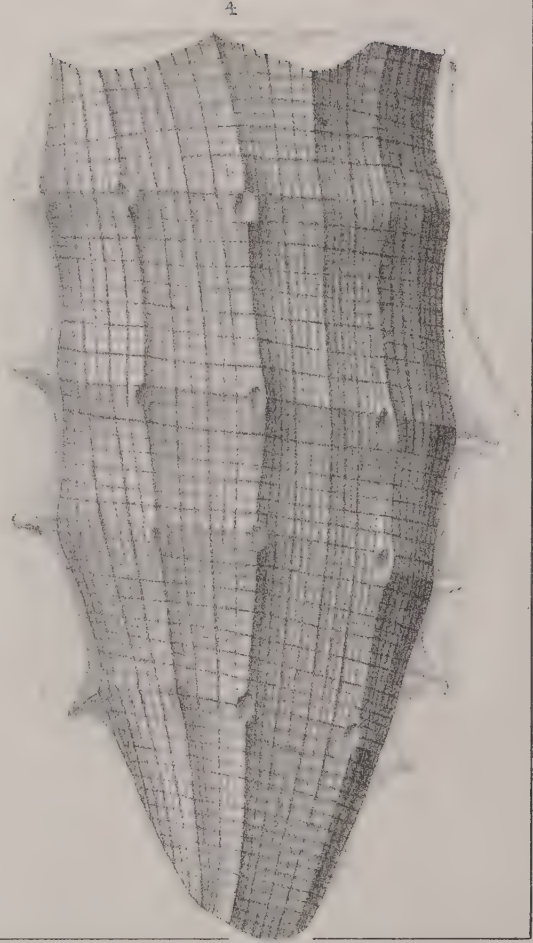


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PLATE V.

HYDRIODICTYA, gen. nov.

Page 817.

(See Plates IV, XVI, XXI.)

HYDRIODICTYA CYLIX, sp. nov.

Page 818.

(See Plate XVI.)

Figures 1, 2. Opposite sides of a small, essentially entire specimen, showing the character of the reticulation. The surface of the sponge is smooth and the apparent swellings and depressions wholly due to compression in fossilization.

Chemung group. *Deyo basin, Naples, New York.*

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS TUBEROSUM, Conrad.

Page 837.

(See Plates II, III, IV, VI, VII, VIII, XXXVIII.)

Figure 3. A long, slender and nearly entire individual, bearing five horizontal rows of nodes with an additional one near the base in an incipient condition; showing the smooth surface in the apertural region, the regular aperture and the tufts at each node, which have been drawn in from impressions left upon the matrix.

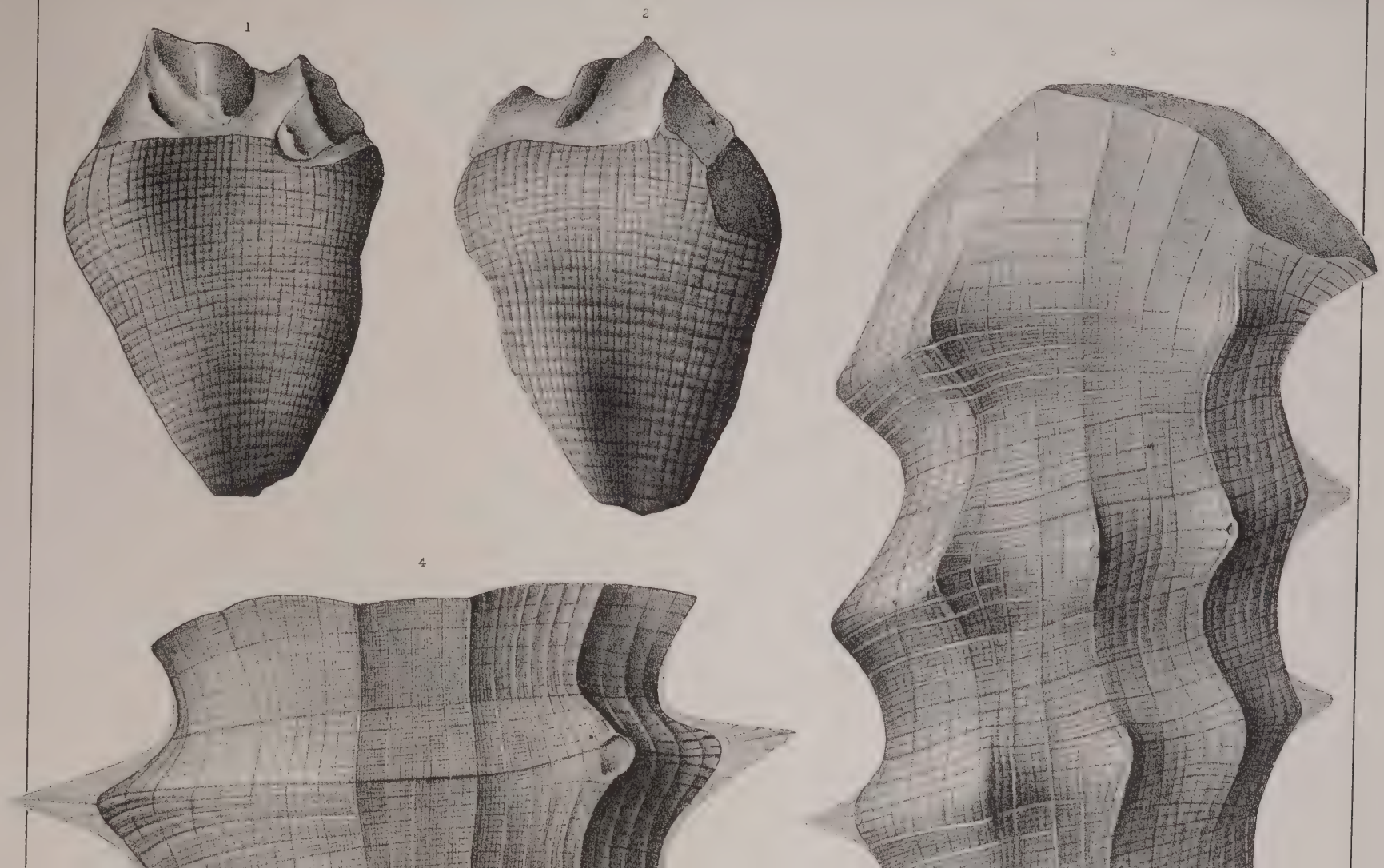
Figure 4. A stouter, more sharply prismatic specimen with more extended tufts, retaining also the vertical lamellae connecting them. The cavities left by the bases of these tufts are shown at the summits of some of the nodes.

Chemung group. *Brown hill, near Cohocton, New York.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate V.



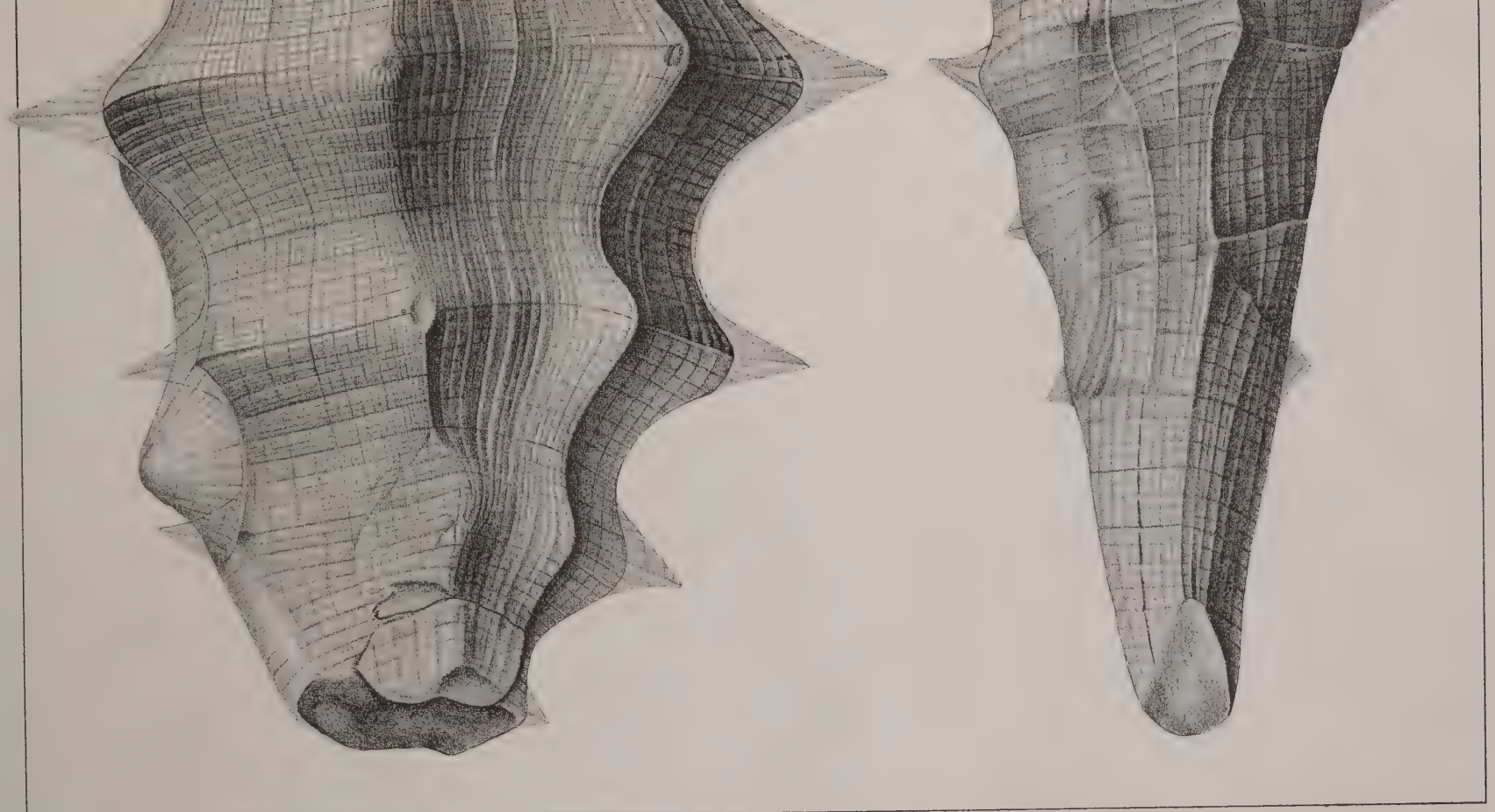


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PLATE VI.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS ANTHRACIS, sp. nov.

Page 849.

(See Plates II, XXXIII.)

Figure 1. A view of the upper portion of an individual, showing the small size of the species, its prismatic form, broad and smooth apertural surface and subcircular nodes. On the right of the specimen the extension of these nodes and their tufts into the matrix is shown.

Figure 2. The opposite side of the same specimen.

Chemung group. *Scio, New York.*

HYDNOCERAS TUBEROSUM, Conrad.

Page 837.

(See Plates II, III, IV, V, VII, VIII, XXXVIII.)

Figure 3. Two small individuals in a block of sandstone which retains impressions of the spicular tufts and lamellae.

Chemung group. *Brown hill, near Cohocton, New York.*

HYDNOCERAS PHYMATODES, sp. nov.

Page 844.

(See Plate XXXVII.)

Figures 4, 5. Opposite sides of a typical specimen having seven horizontal rows of low nodes; in the second and third rows there being eight nodes, in the fourth, nine, in the fifth and sixth, eleven. In the fifth horizontal row in figure 5, an intercalary node begins a new vertical row.

Chemung group. *Bath, New York.*

DICTYOSPONGIDÆ.

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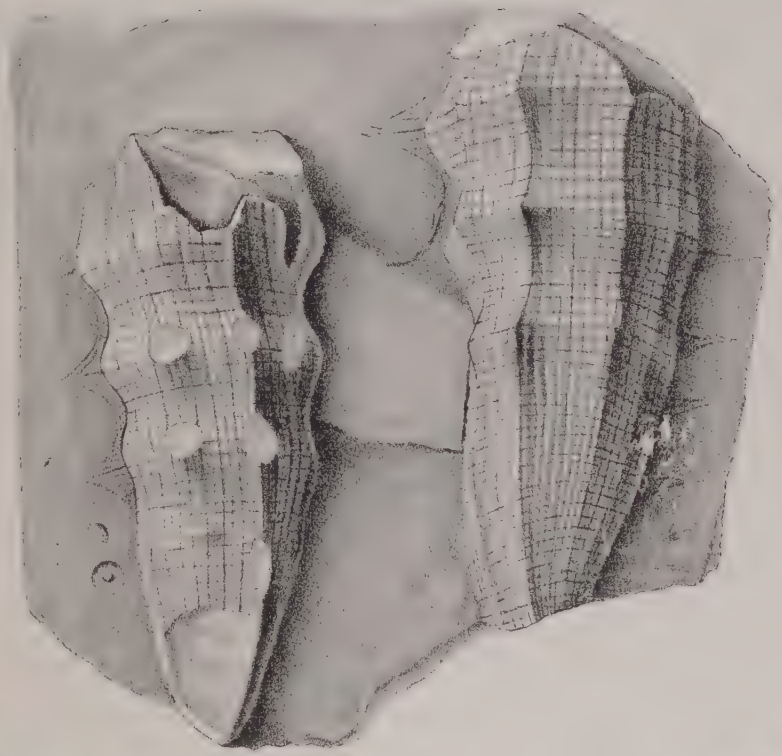
Plate VI

1



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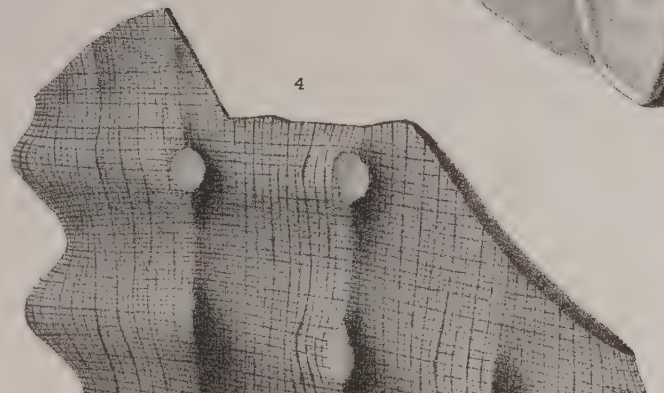

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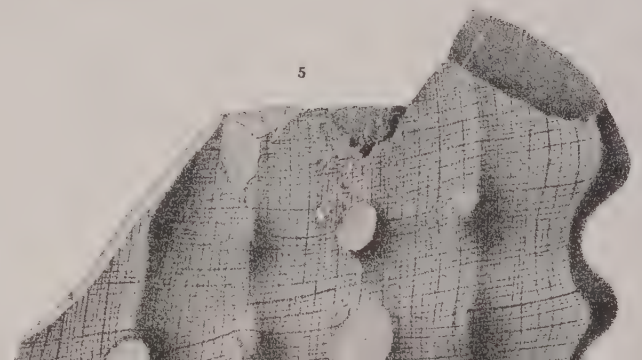

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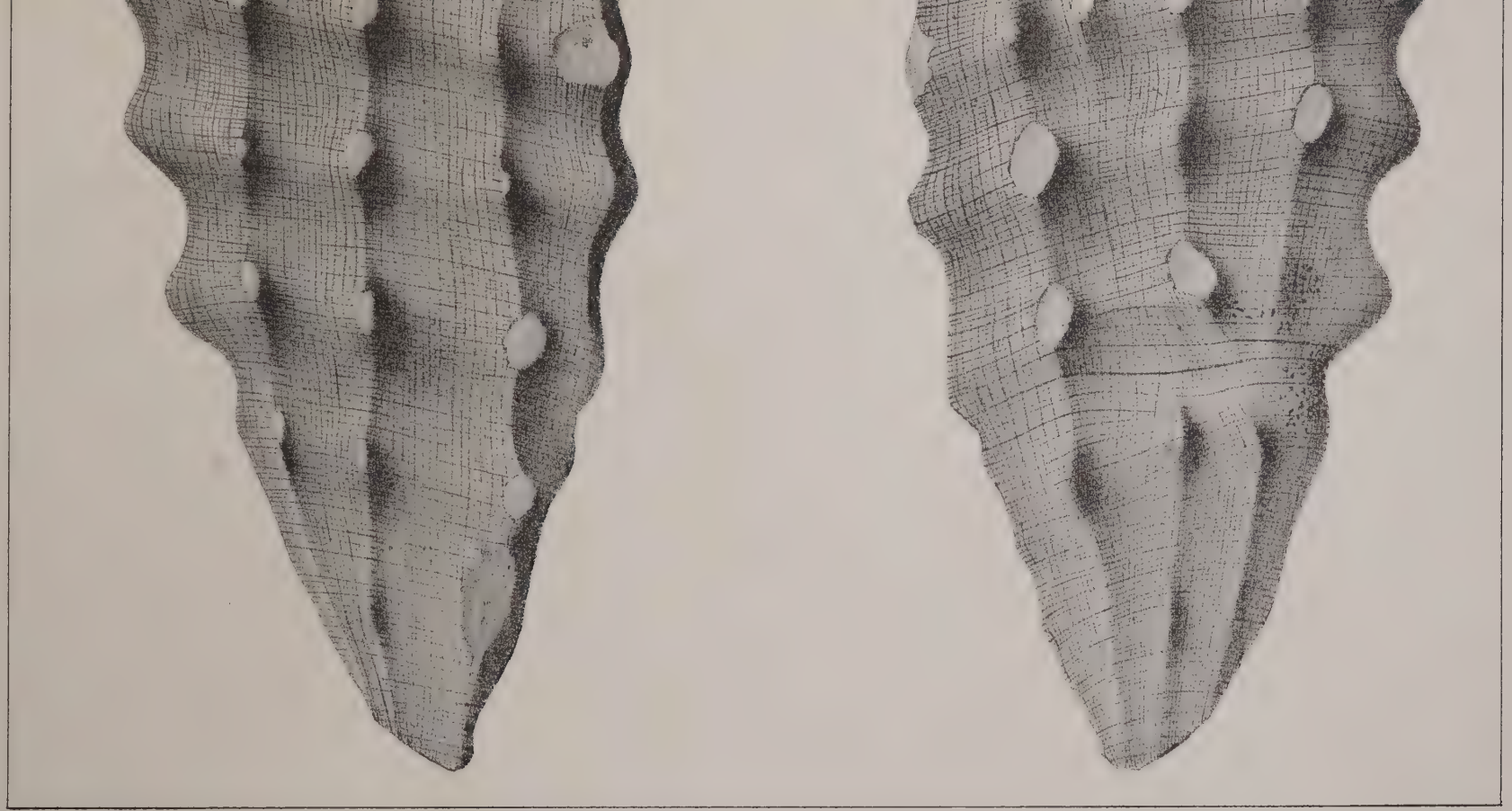

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PLATE VII.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS HYPASTRUM, sp. nov.

Page 845.

Figure 1. A transverse section viewed from beneath; showing the circular body of the species, and its strong, elongate pendant nodes arranged in pairs elevated on stout bases.

Chemung group. *Middle or southern part of Steuben county, New York.*

HYDNOCERAS TUBEROSUM, Conrad.

Page 837.

(See Plates II, III, IV, V, VI, VIII, XXXVIII.)

Figure 2. The basal portion of a small, nearly entire individual with low nodes and of irregular growth on one side; showing the abrupt appearance of an intercalary node near the top.

Figure 3. An entire specimen in which the growth has been interrupted, evidently by some accident, and the reticulum repaired, not however, without the disturbance and obliteration of most of the nodes. There is no actual break or tear in the reticulum as might be inferred from the appearance of the drawing near the top.

Chemung group. *Brown hill, near Cohocton, New York.*

HYDNOCERAS TUBEROSUM, Conrad, var. GLOSSEMA, var. nov.

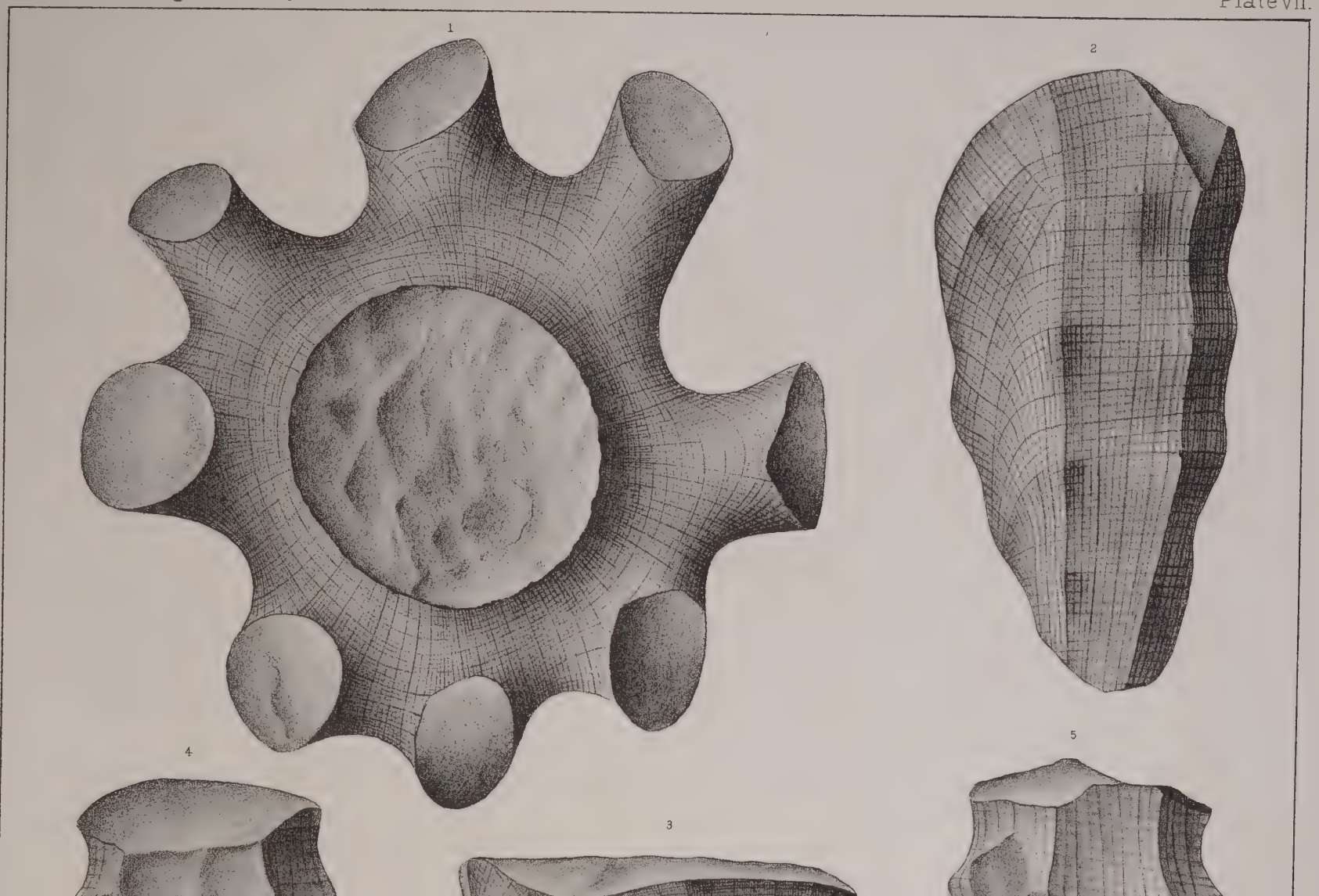
Page 841.

(See Plate IX.)

Figures 4, 5. Opposite sides of a nearly entire example, having a very slender form and six horizontal rows of sharp nodes which have been made to appear rather too broad at the lateral margins.

Chemung group. *Southwestern New York (exact locality uncertain).*

DICTYOSPONGIDÆ.



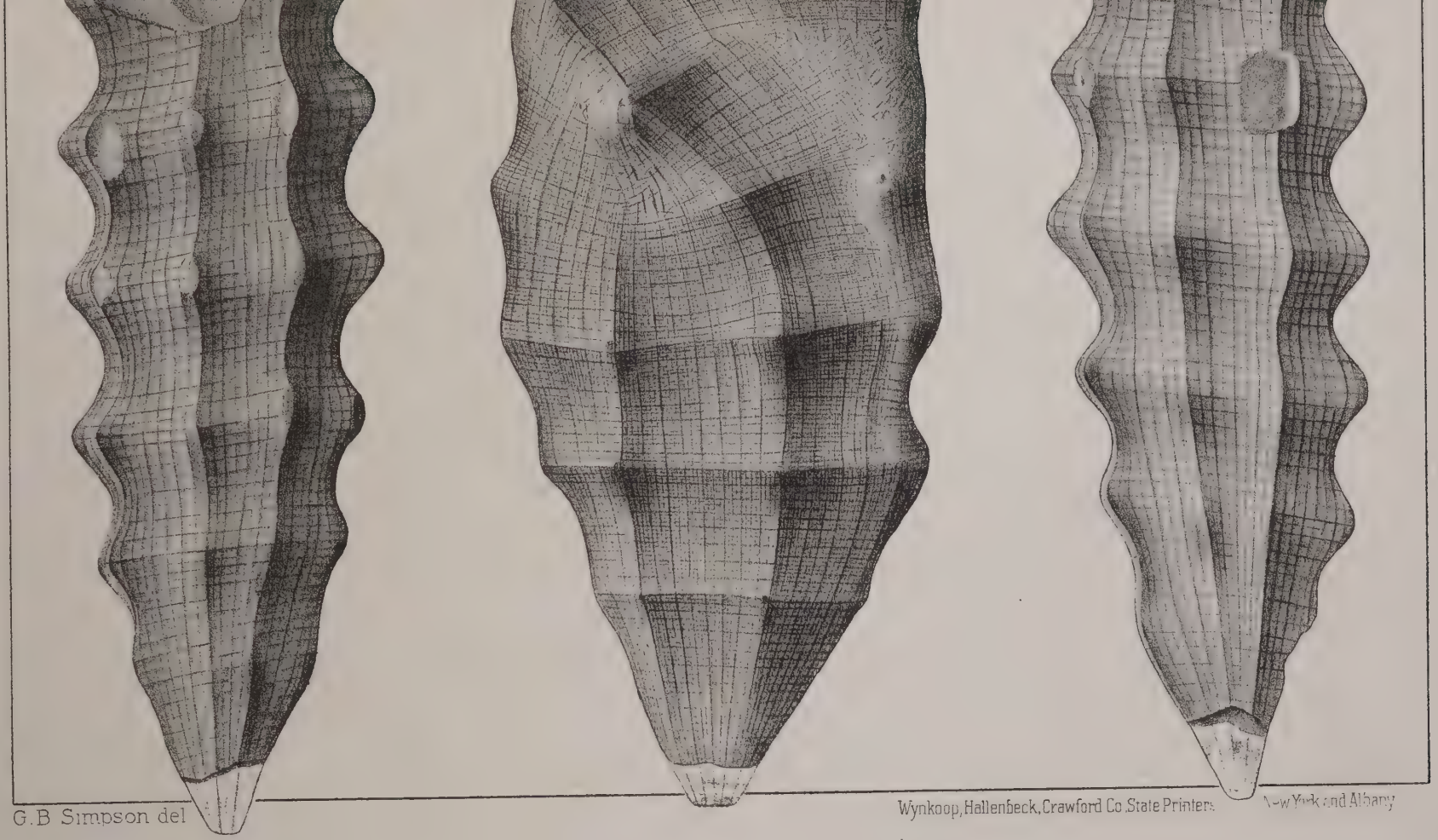


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PLATE VIII.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII XXXIX, XLVI.)

HYDNOCERAS TUBEROSUM, Conrad.

Page 837.

(See Plates II, III, IV, V, VI, VII, XXXVIII.)

Figure 1. The basal extremity of a large individual, showing the very obscure nodes and sharply defined prism-faces.

Figure 2. A nearly entire individual with four well defined horizontal rows of low and sharp nodes, and broad, gently and regularly expanded apertural region bearing only two small nodes belonging to the median vertical series. Near the apex of the specimen the prismatic faces are more obscure than elsewhere.

Chemung group. *Brown hill, near Cohocton, New York.*

HYDNOCERAS sp.

Page 851.

Figure 3. An imperfect and irregular fragment representing a moderately large undescribed species of this genus, from an horizon where such forms are of very rare occurrence.

Chemung group. *Wellsville, New York.*

HYDNOCERAS BATHENSE, sp. nov.

Page 841.

(See Plates III and IX.)

Figure 4. A nearly entire example, with four horizontal rows of strong nodes; showing the fine reticulation of the surface and the obsolescence of the prismatic faces.

Chemung group. *Jenks quarry, Bath, New York.*

HYDNOCERAS EUTHELES, sp. nov.

Page 845.

(See Plate XXXIII.)

Figures 5, 6. Two fragments representing like parts of two individuals and showing the broad form of the sponge and the narrow, extended and drooping nodes.

Chemung group. *Cotton hill, near Avoca, New York.*

DICTYOSPONGIDÆ.

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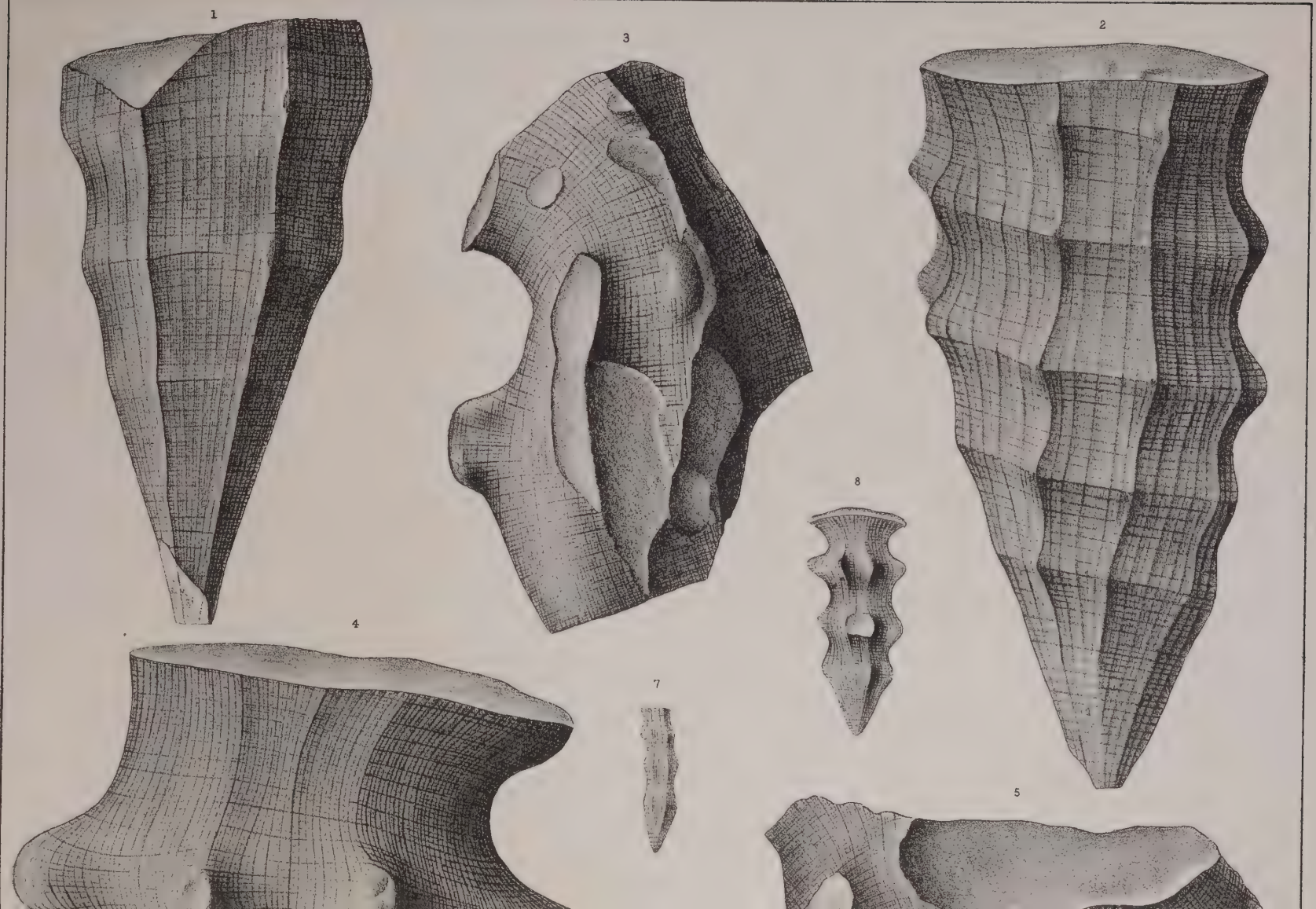
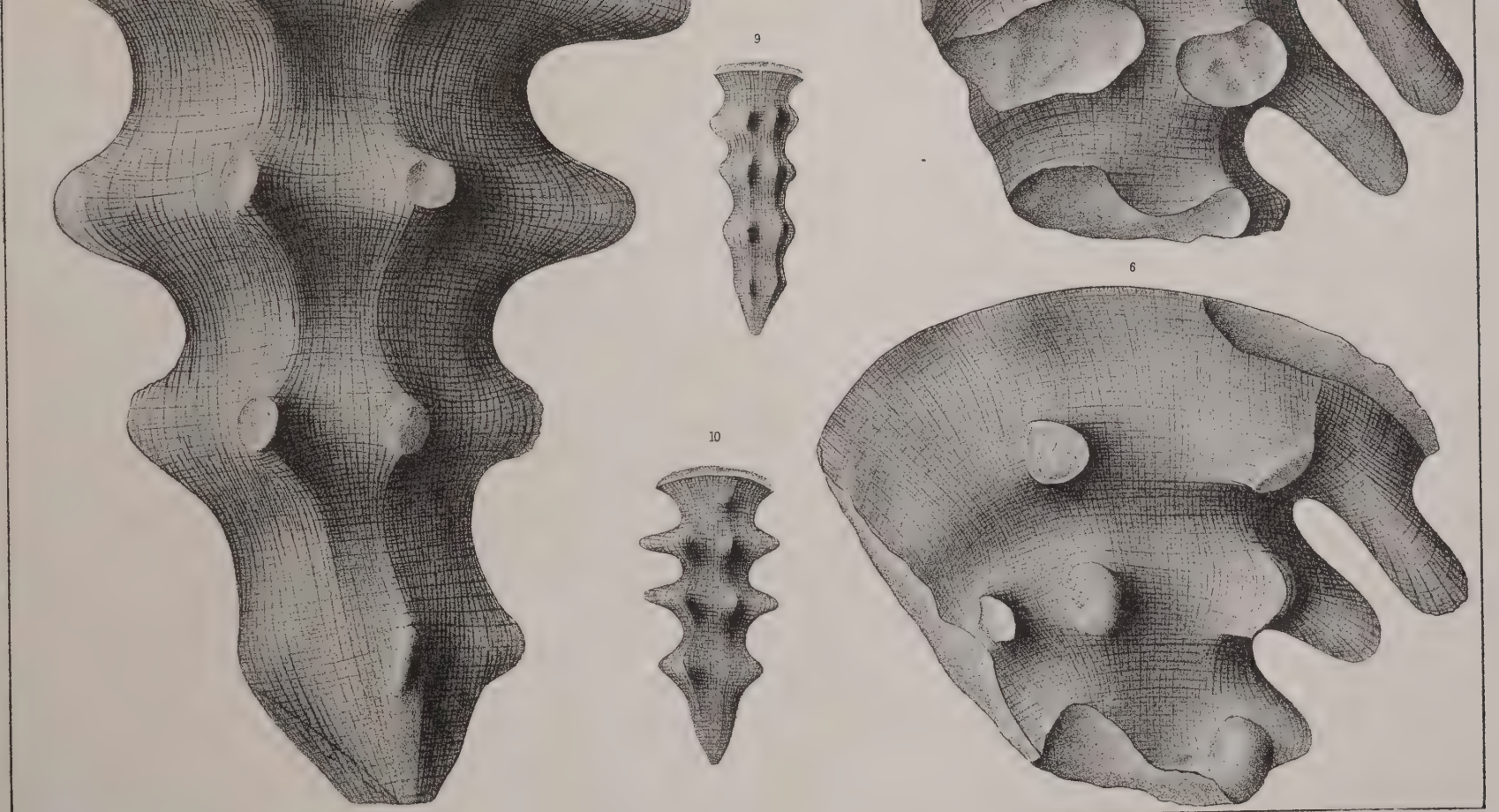
Plate VIII.





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HYDNOCERAS LUTHERI, sp. nov.

Page 846.

Figure 7. A young and slender specimen with low nodes.

Figure 8. An entire individual with three well developed rows of nodes and entire aperture.

Figure 9. A mature individual with four horizontal rows of nodes.

Figure 10. A full-grown example with strong nodes in three rows and an accessory node in the apertural region.

Chemung group. *Segur's gully, Italy, Yates county, New York.*

PLATE IX.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS BATHENSE, sp. nov.

Page 841.

(See Plates III, VIII.)

Figure 1. A large, somewhat incomplete individual with six rows of strong rounded nodes, showing some interesting peculiarities of development. In the fourth row one node, instead of appearing at its proper place, stands at the middle of the prism-face, and in the fifth row the node of a different vertical series is wanting, while in the sixth row, so far as it is preserved, there is but a single well defined node. Chemung group. *Jenks quarry, Bath, New York.*

HYDNOCERAS TUBEROSUM, Conrad, var. GLOSSEMA, var. nov.

Page 841.

(See Plate VII.)

Figure 2. In this example there is a considerable area at the base, where an incipient row of nodes is represented only by a series of broad swellings at the prism-angles. Three horizontal rows are well developed, and in the apertural region is evidence of another row of smaller nodes. The two lower rows (not including the incipient row near the base) have seven nodes, while that immediately above has eight, the eighth vertical row appearing abruptly, as shown in the figure. The reticulation is sharply defined, but not finely divided. The surface shows impressions of worm-like markings which, as elsewhere suggested, may be the tube of some commensal annelid.
Chemung group. *Southwestern New York (exact locality unknown).*

HYDNOCERAS AVOCA, sp. nov.

Page 843.

(See Plates II, X, XI.)

Figure 3. An imperfect example with three fully developed horizontal rows of large and short nodes with subsemicircular marginal outline, and an inceptive basal row. The prismatic faces are obscured, except over the basal region, and the horizontal constrictions are deep and narrow. Chemung group. *Near Avoca, New York.*

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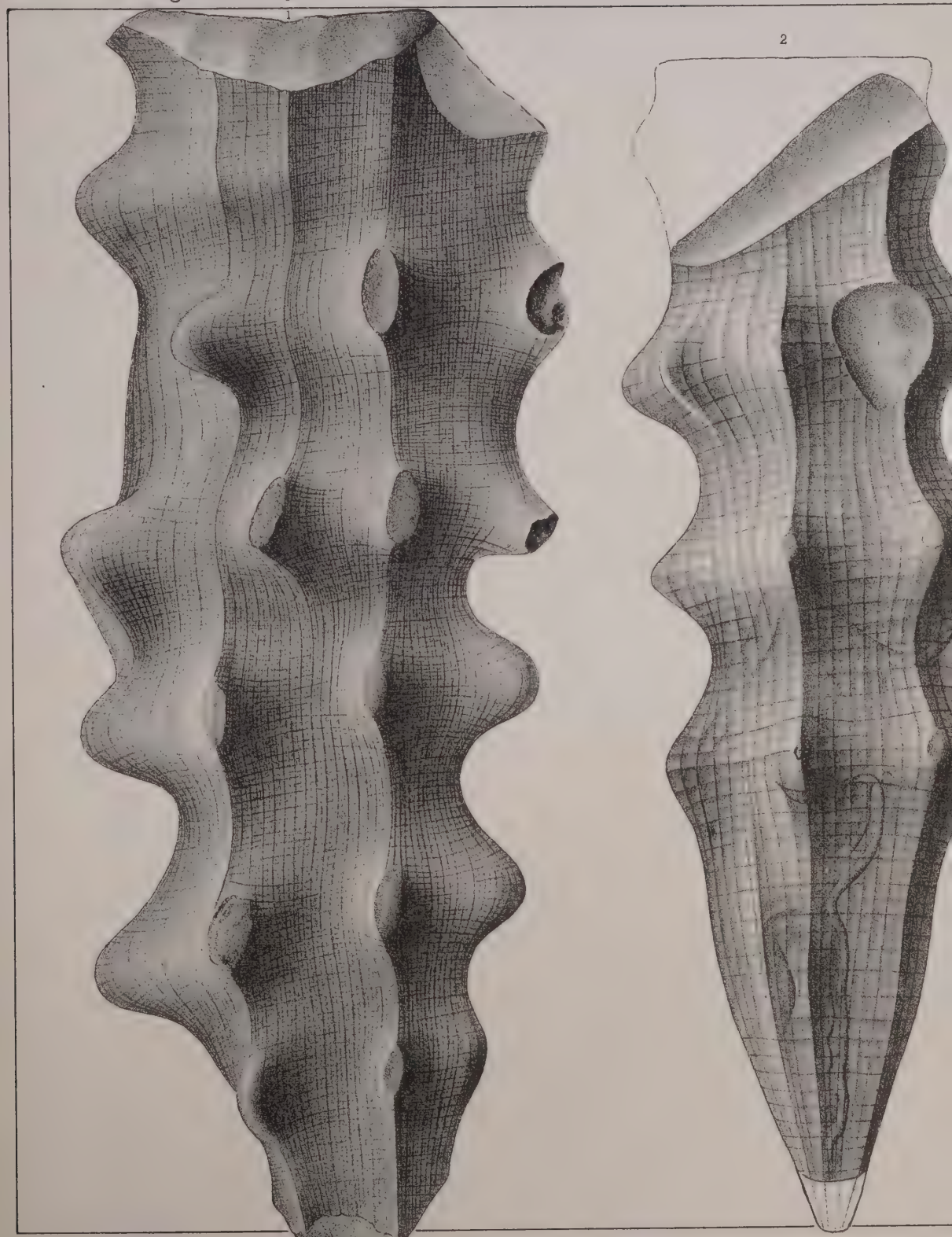

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Plate IX.

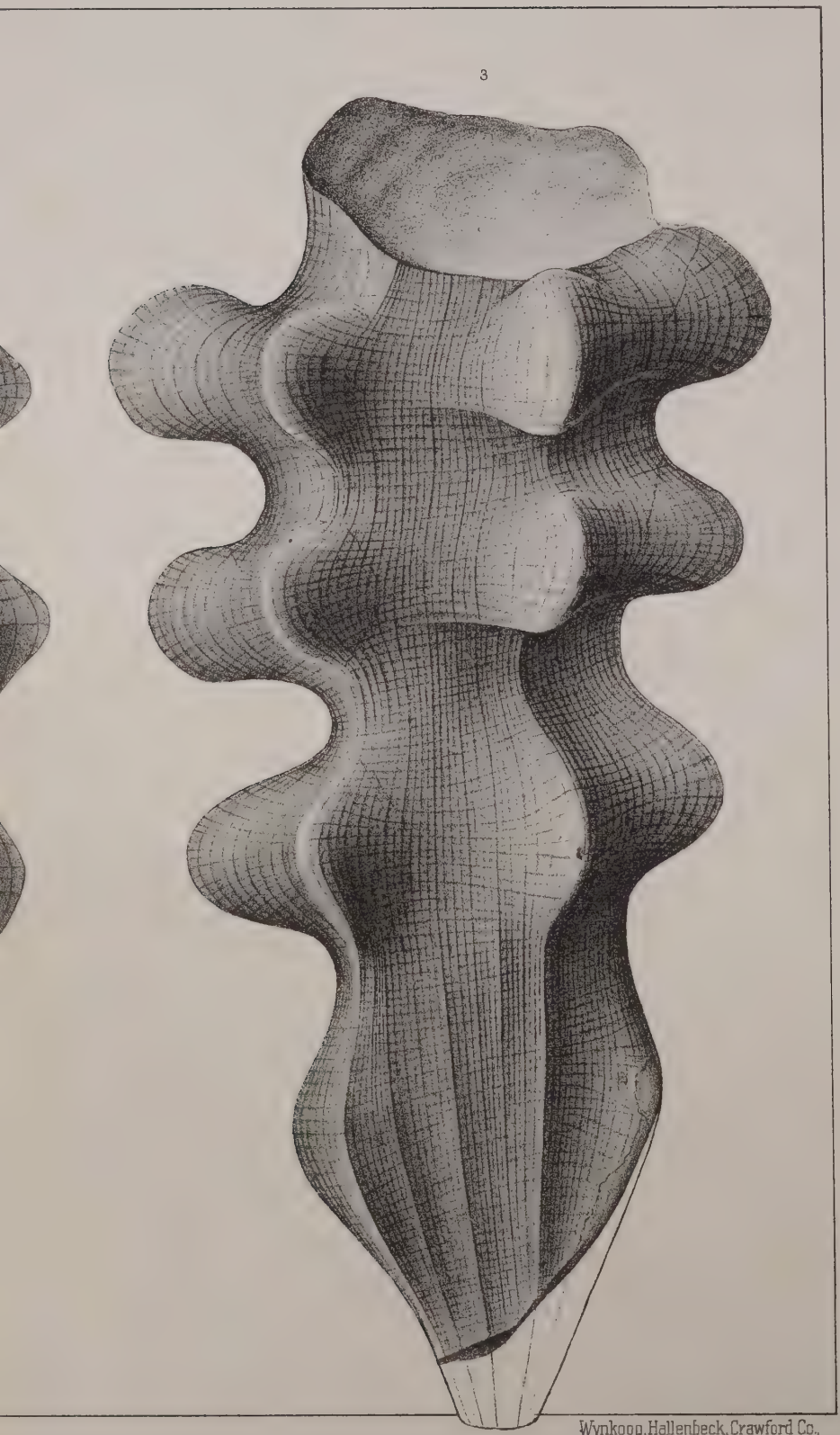

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PLATE X.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, IX, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS AVOCA, sp. nov.

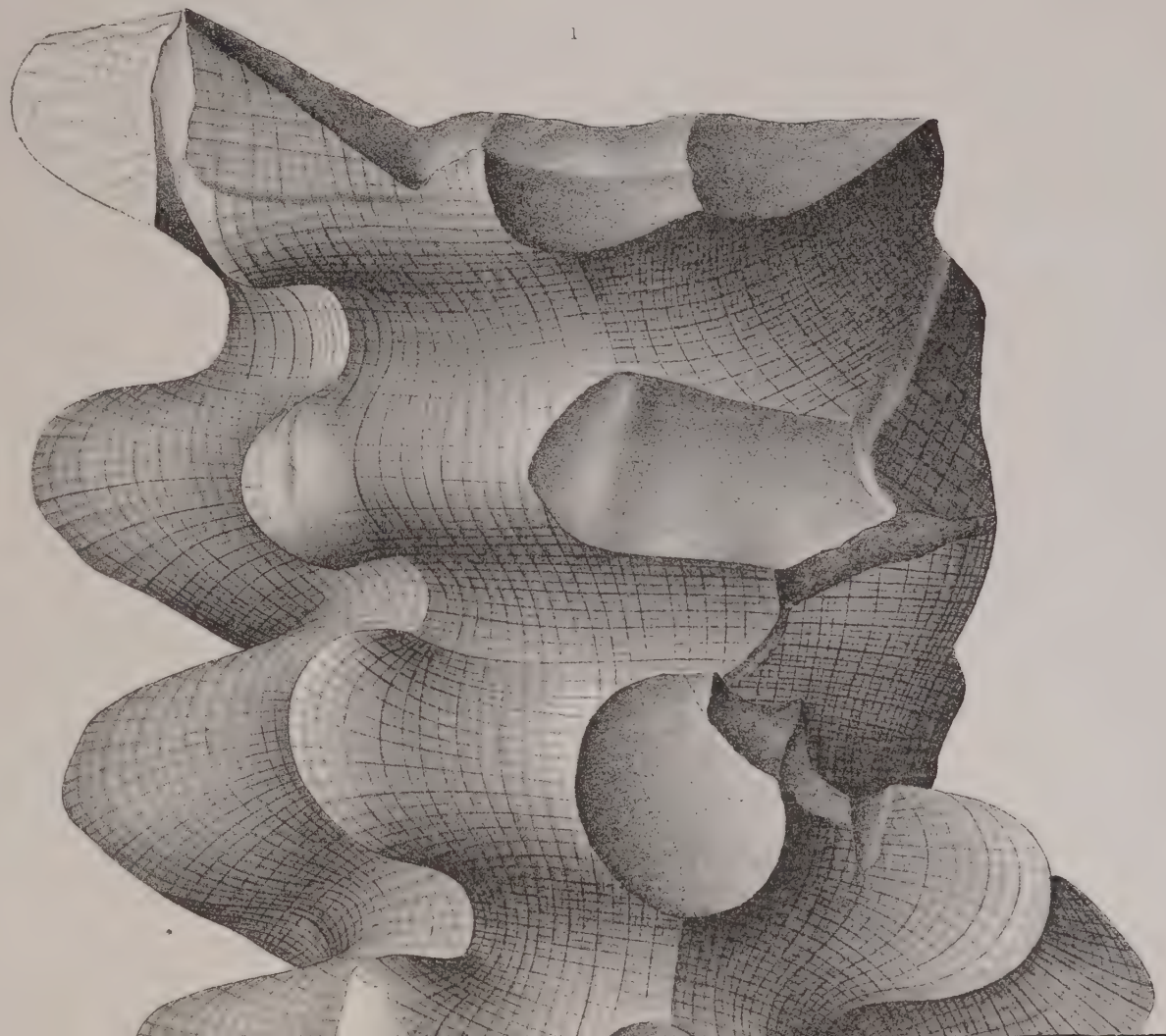
Page 843.

(See Plates II, IX, XI.)

Figure 1. A large, somewhat incomplete example with five horizontal rows of fully developed nodes and an incipient row near the base. This specimen shows the great size of the nodes, their semielliptical or semicircular outline and the deep and narrow horizontal constrictions by which they are separated.

Chemung group. *Near Avoca, New York.*

DICTYOSPONGIDÆ.



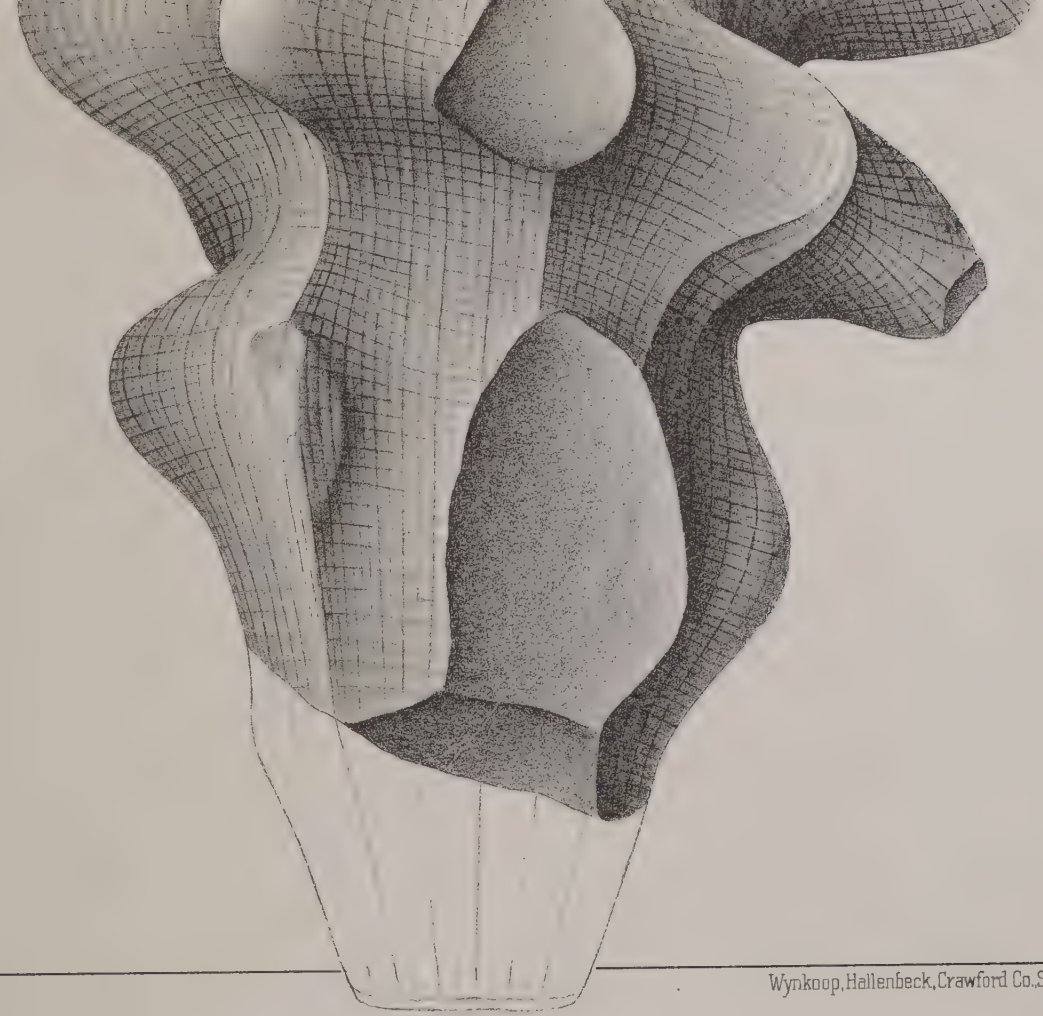


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PLATE XI.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS AVOCA, sp. nov.

Page 843.

(See Plates II, IX and X.)

Figure 1. This specimen represents the apertural and upper portion of a gigantic individual of this species, whose probable original proportions are partially restored in outline. The sponge is somewhat irregularly compressed, and the nodes upon its surface have been flattened without destroying their characteristic expression in this species. The specimen was taken from the foundation wall of an old mill at Avoca, and its exact locality is not known, though doubtless from the beds in that vicinity which have produced most of the known examples of this species.

Chemung group. *Avoca, New York.*

DICTYOSPONGIDÆ.

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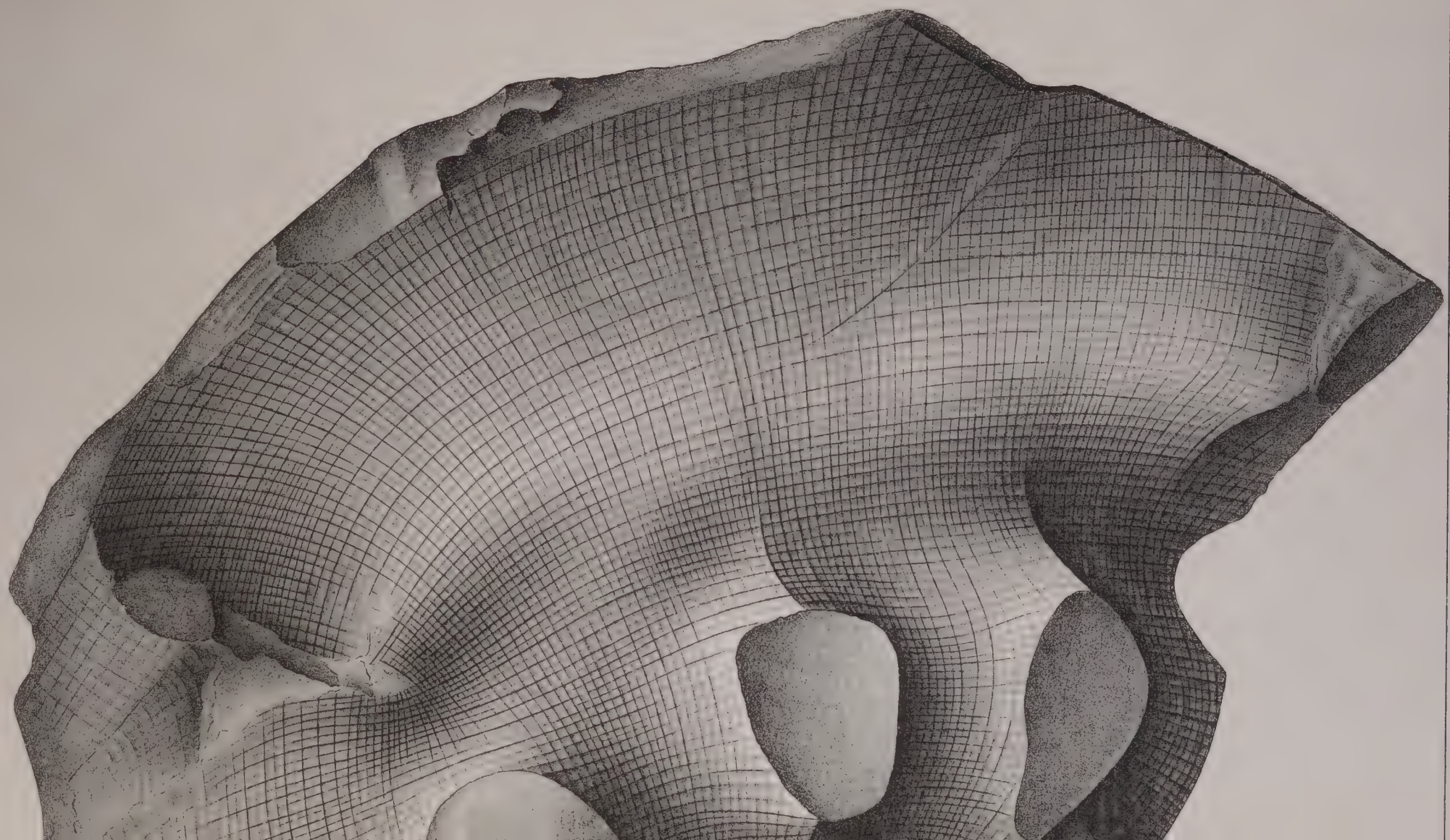

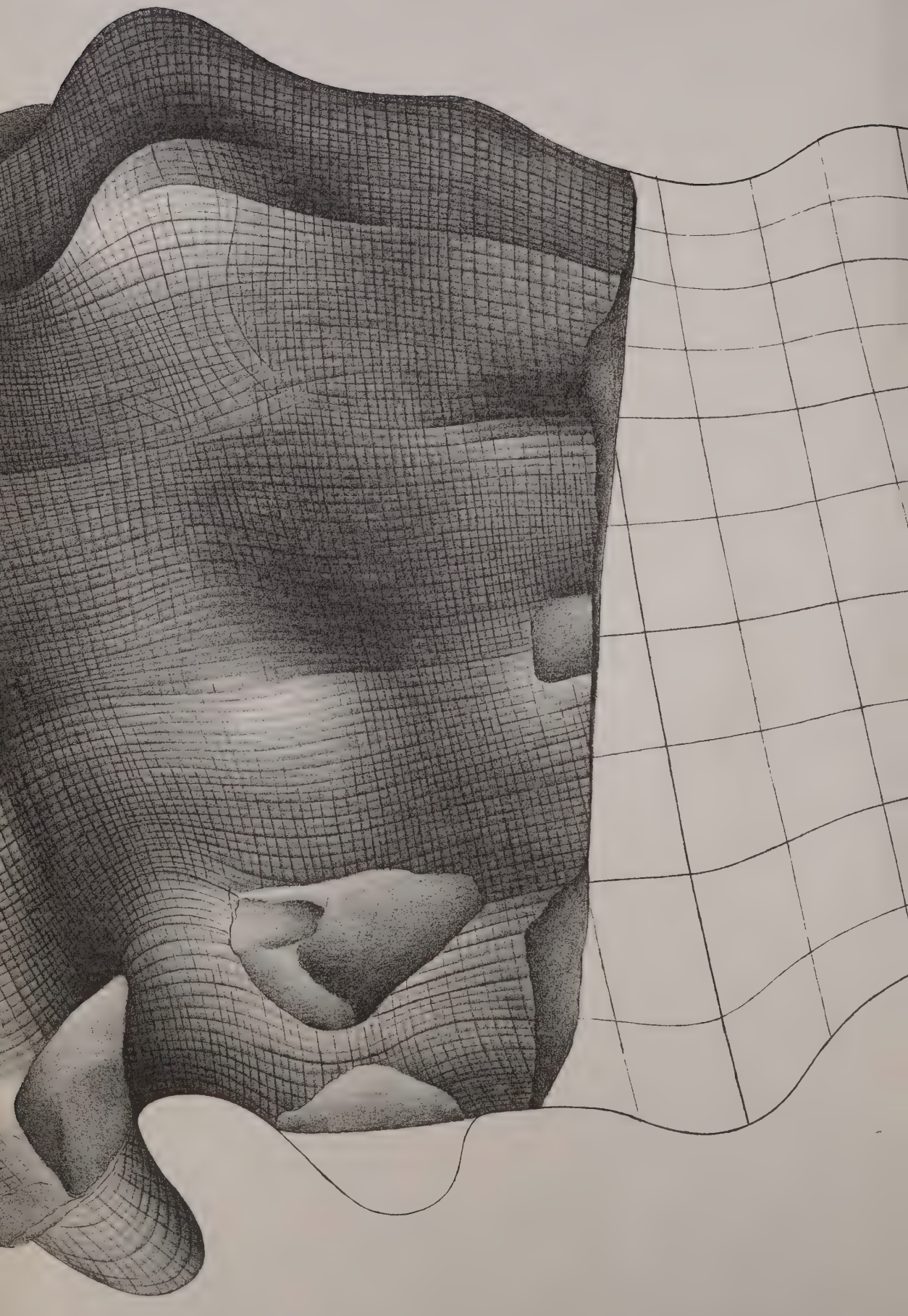

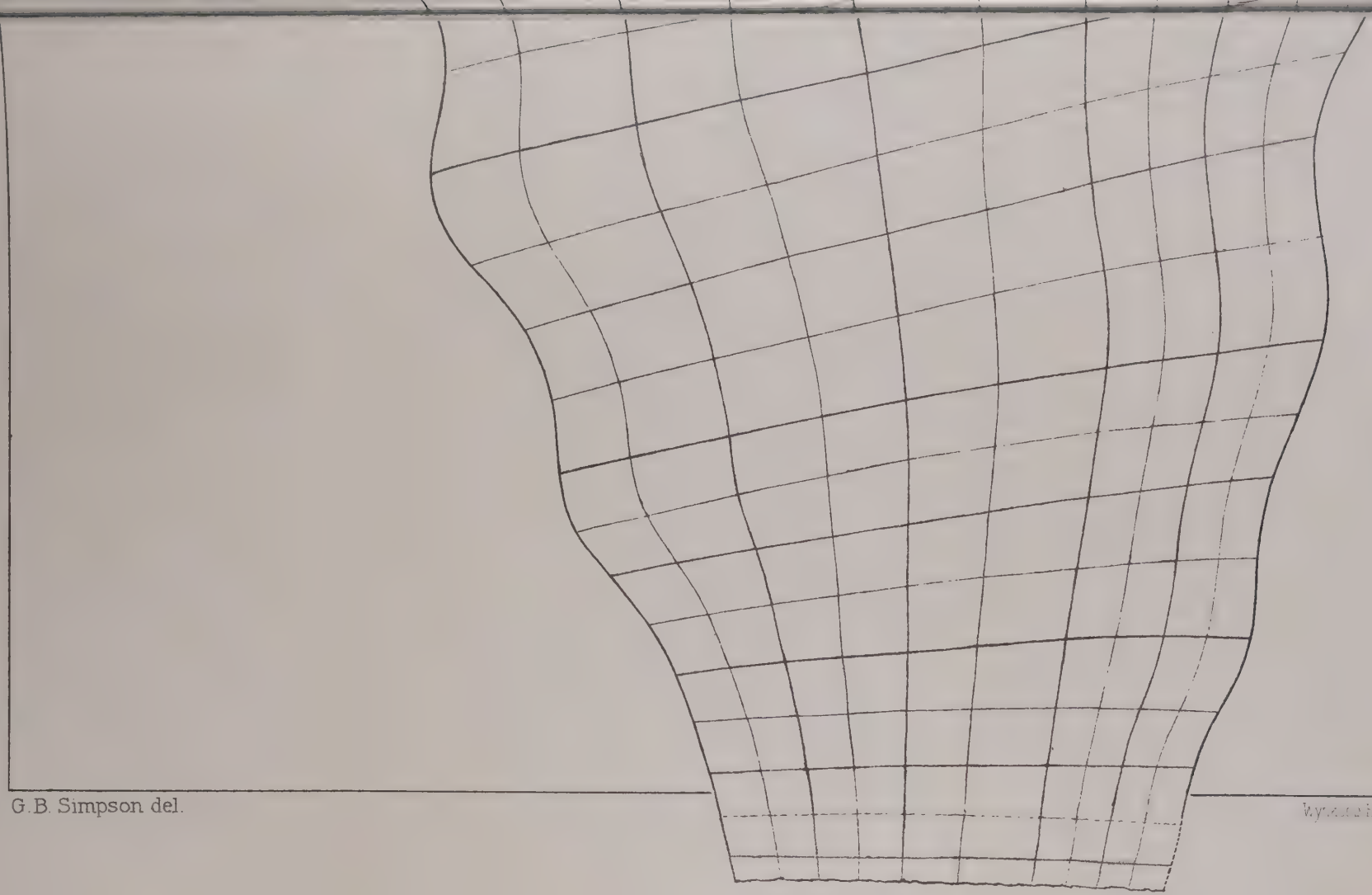

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PLATE XII.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS EUMECES, sp. nov.

Page 850

Figures 1, 2, 3. Three fragments of one specimen which consists of a large cup greatly compressed along the vertical axis. Figure 1 shows a portion of the internal cast, figures 2 and 3 impressions of the exterior, indicating the depth of the horizontal constrictions, and showing the sharp, tufted nodes and the character of the reticulation. Chemung group. *Alfred, New York.*

DICTYOSPONGIDÆ.

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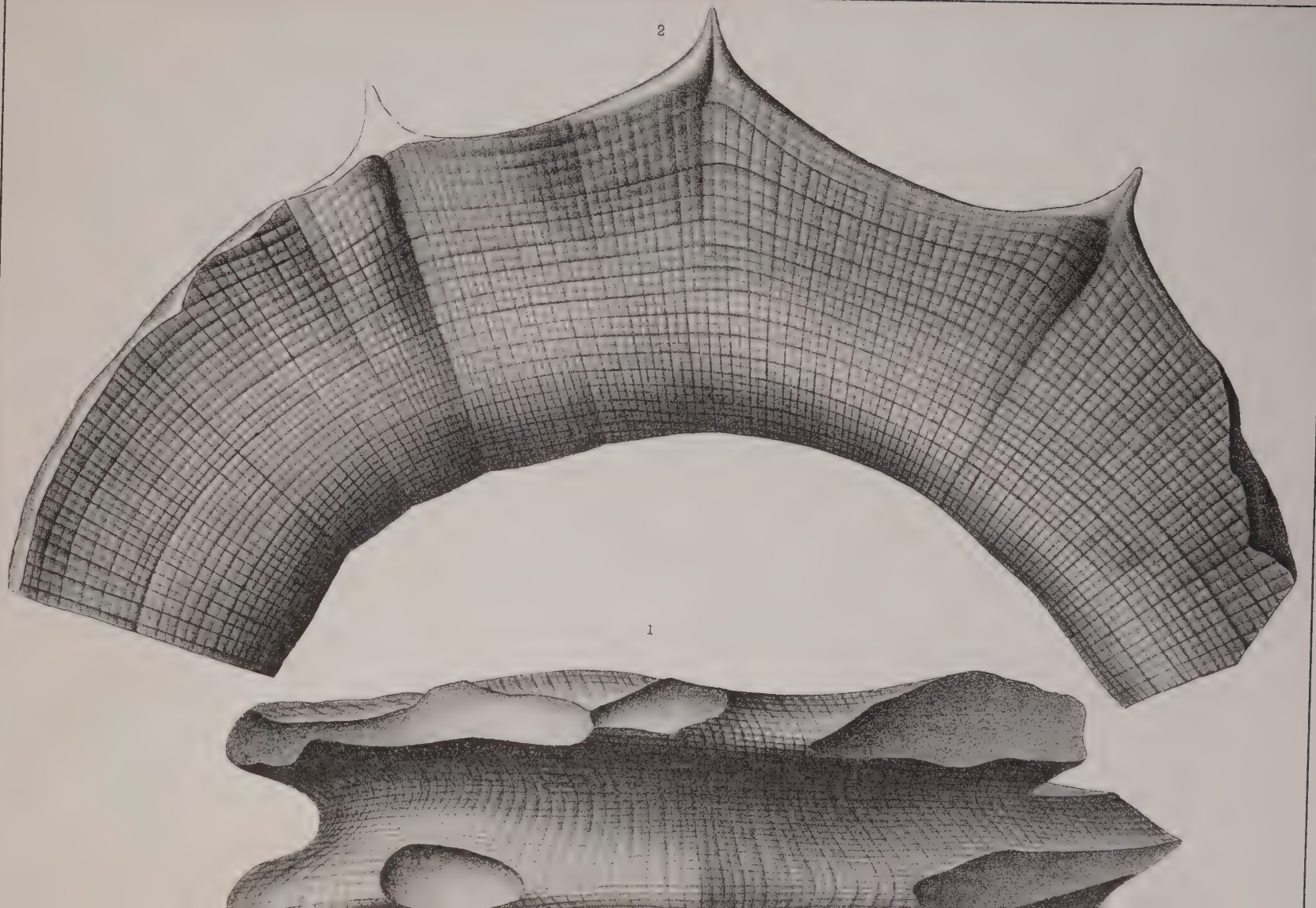
Plate XII.



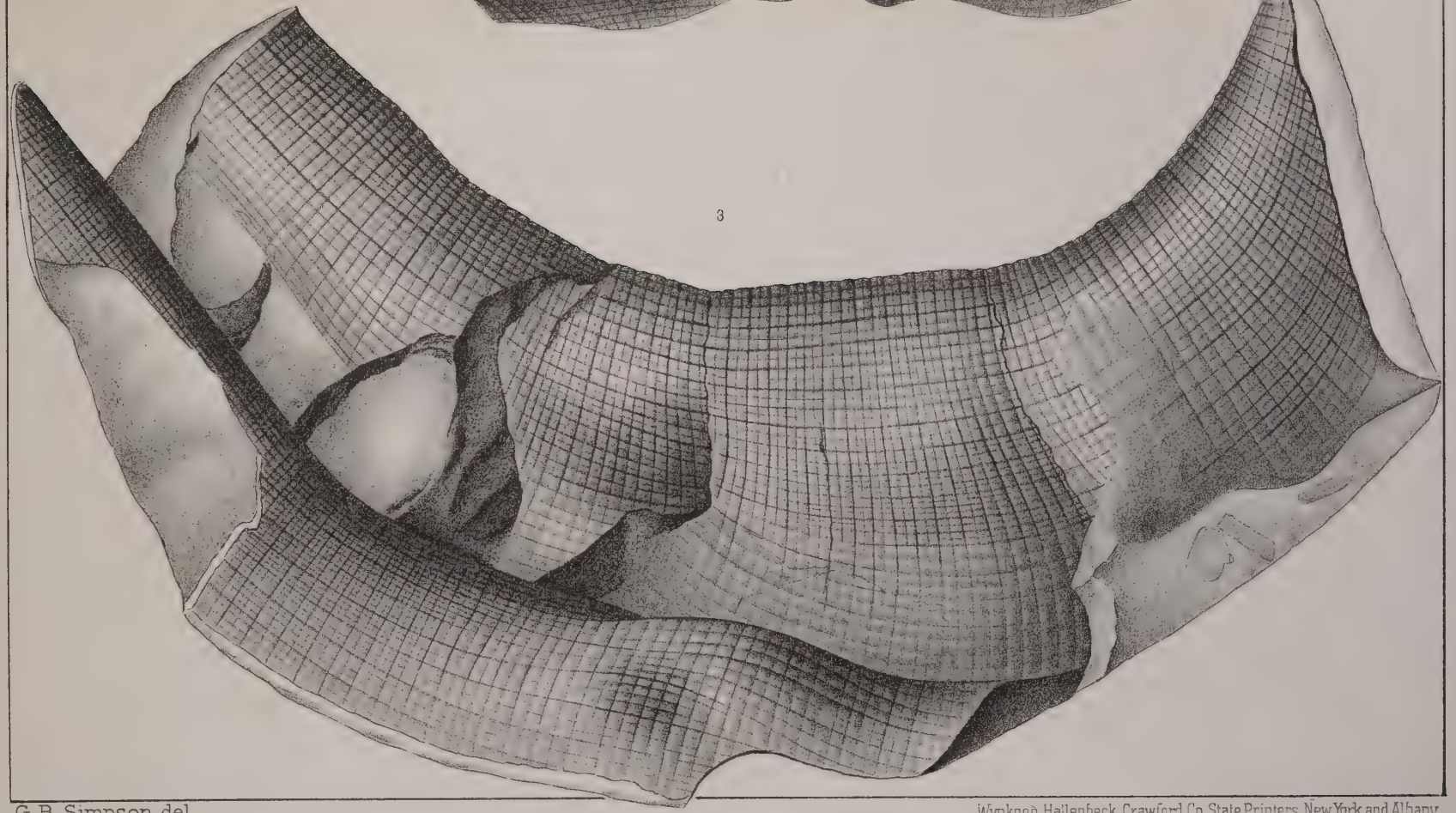


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PLATE XIII.

BOTRYODICTYA, gen. nov.

Page 851.

BOTRYODICTYA RAMOSA, Lesquereux (sp.).

Page 851.

Figure 1. A compressed and imperfect specimen showing the three rows of compound nodes and the single row of simple nodes in the apertural region. These nodes have all been much flattened and considerably distorted. The pedicel is partially retained.

Figure 2. A transverse section of a specimen showing a portion of the apertural nodes in their normal extent and form.

Figure 3. The other side of the specimen represented in figure 1.

Figure 4. A laterally compressed specimen viewed from the base of the cup, showing the outward extent of the nodes.

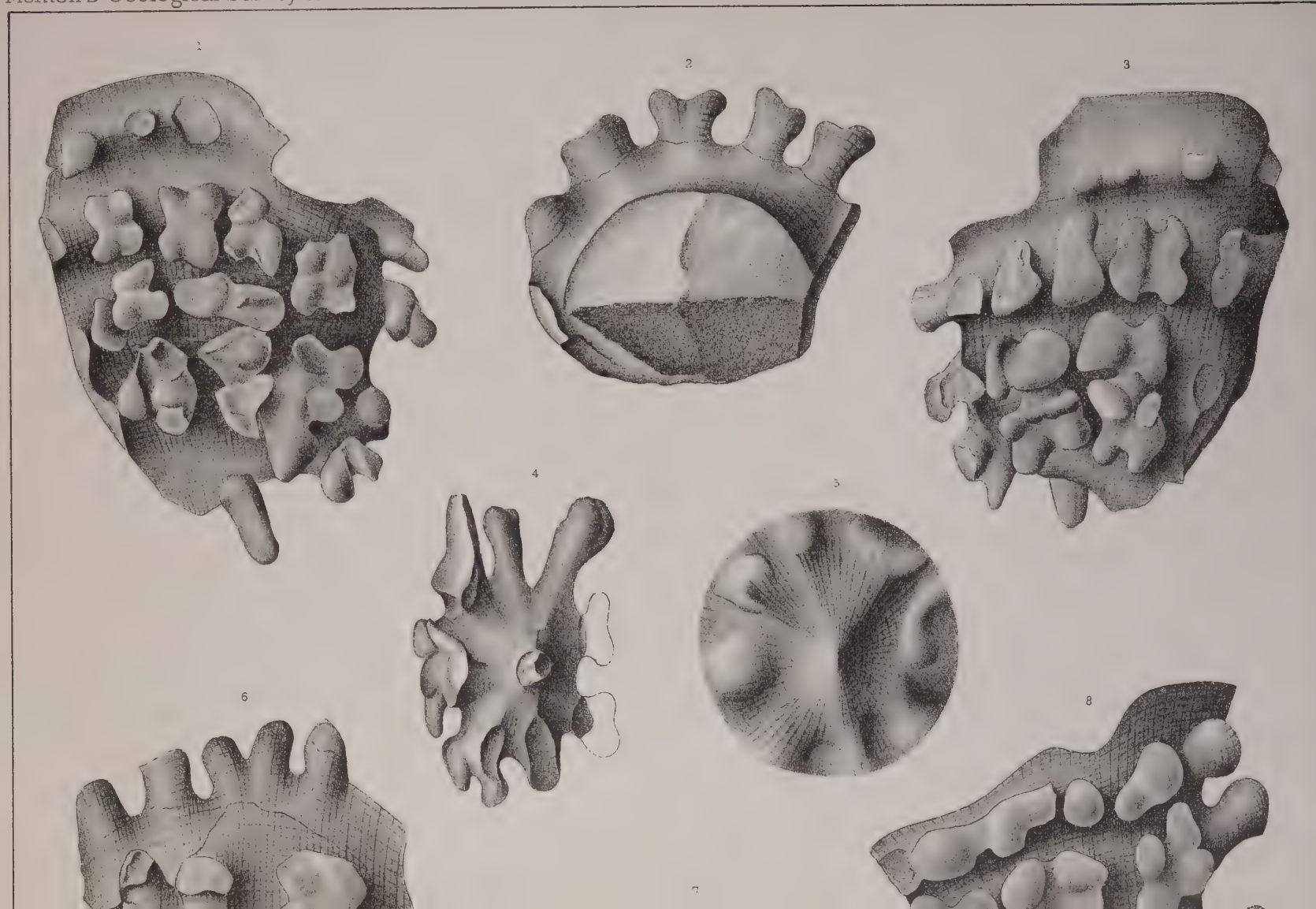
Figure 5. An apical view of a gutta-percha cast taken from the interior of the base of the cup; showing that the vertical bands of the cup converge to an apex and form a distinct internal reticular wall or diaphragm at this plane.

Figure 6. A specimen having an unusually large vase and slender pedicel. This example shows the obsolescence of the prismatic faces, the erect, bilobed or simple subapertural nodes and the pendulous compound nodes of the lower rows.

Figure 7. The opposite side of the same individual, only a portion of the surface and lobes being exposed, more below than above. The erect node at the summit is apparently a division of one of the apertural nodes.

Figure 8. The most complete individual obtained; showing the form of the cup and its nodes, and a portion of the long, smooth reticulate pedicel. Chemung group. *Lawrenceville, Tioga county, Pennsylvania.*

DICTYOSPONGIDÆ.



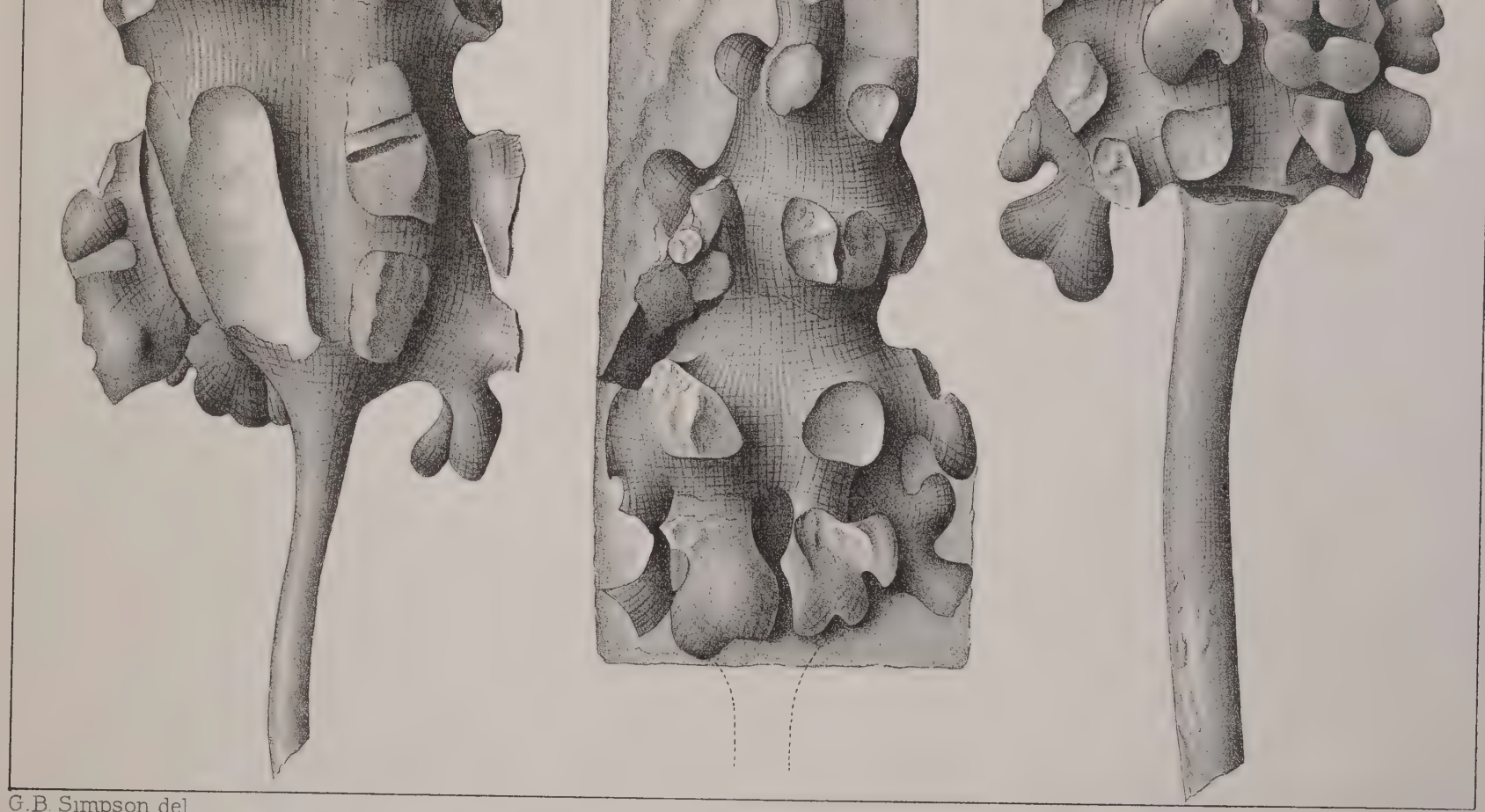


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PLATE XIV.

CLATHROSPONGIA, Hall.

Page 861.

(See Plates XV, XVIII, XXI, XXV, XLIX, L.)

CLATHROSPONGIA (?) HAMILTONENSIS, Hall (sp.).

Page 806.

Figure 1. The original specimen, which is a calcareous replacement of the skeleton; showing the strong primary bands and the imperfectly retained lesser bands; also exhibiting the minute reticulation over small patches near the middle of the surface.
In the calcareous shales of the Hamilton group. *Canandaigua lake, New York.*

CLATHROSPONGIA FENESTRATA, Hall (sp.).

Page 862.

(See Plate XXV.)

Figure 2. A view of the original specimen, from the drawing given in the Sixteenth Annual Report of the N. Y. State Cabinet of Natural History, 1863, pl. 3, fig. 4.
Chemung group. *Chemung narrows, New York.*

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

Page 813.

(See Plates XV, XVI, XXVII, XXXVI.)

Figure 3. A slender, well preserved and nearly entire individual, showing the prevailing form of the species and the elongate rectangular shape of the primary meshes of the net-work.

Figure 4. A specimen of similar character, but accidentally curved.
Chemung group. *Friendship, New York.*

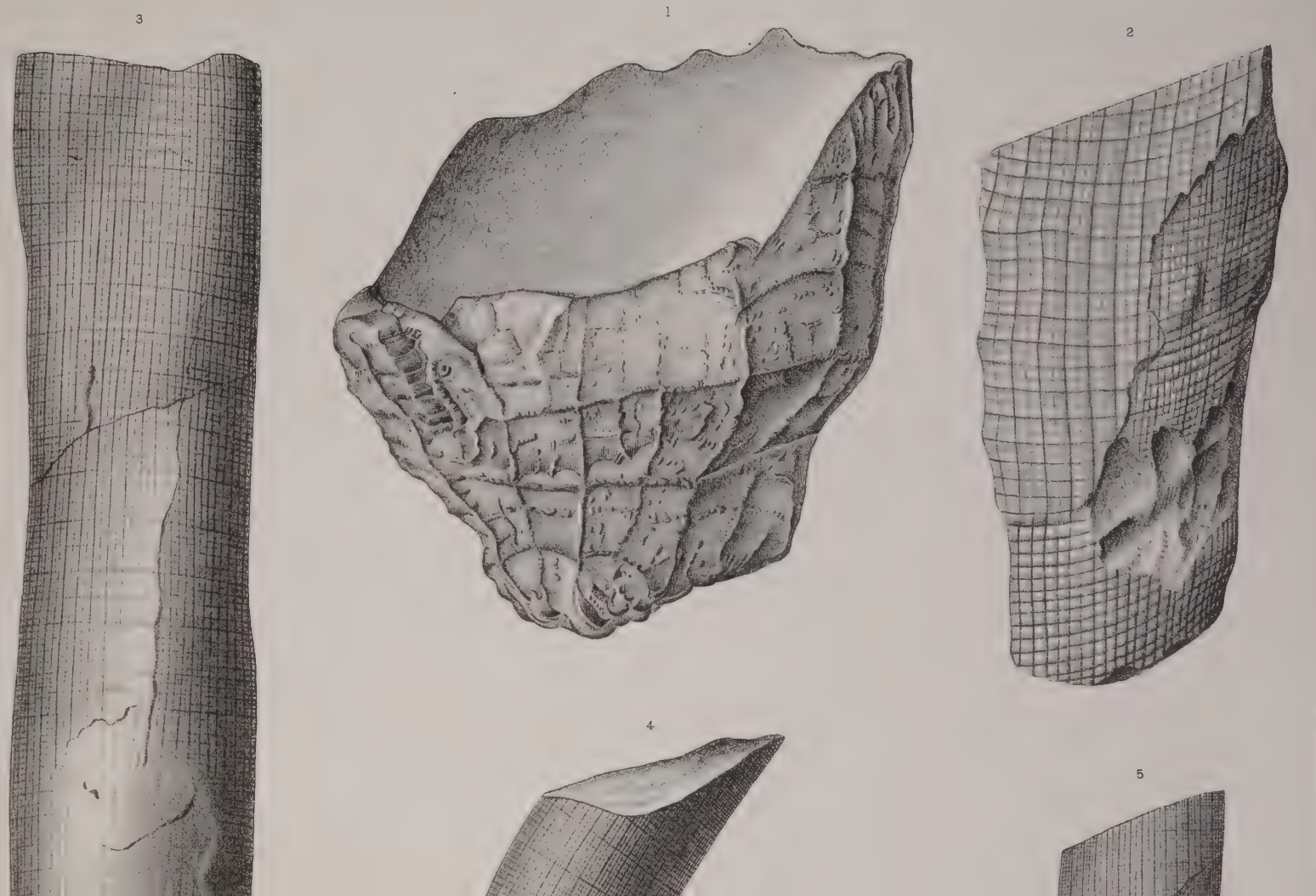
Figure 5. A somewhat smaller example preserving the finer divisions of the reticulum.

Figure 6. Two very small examples regarded as the young of this species.
Chemung group. *Wellsville, New York.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate XIV.



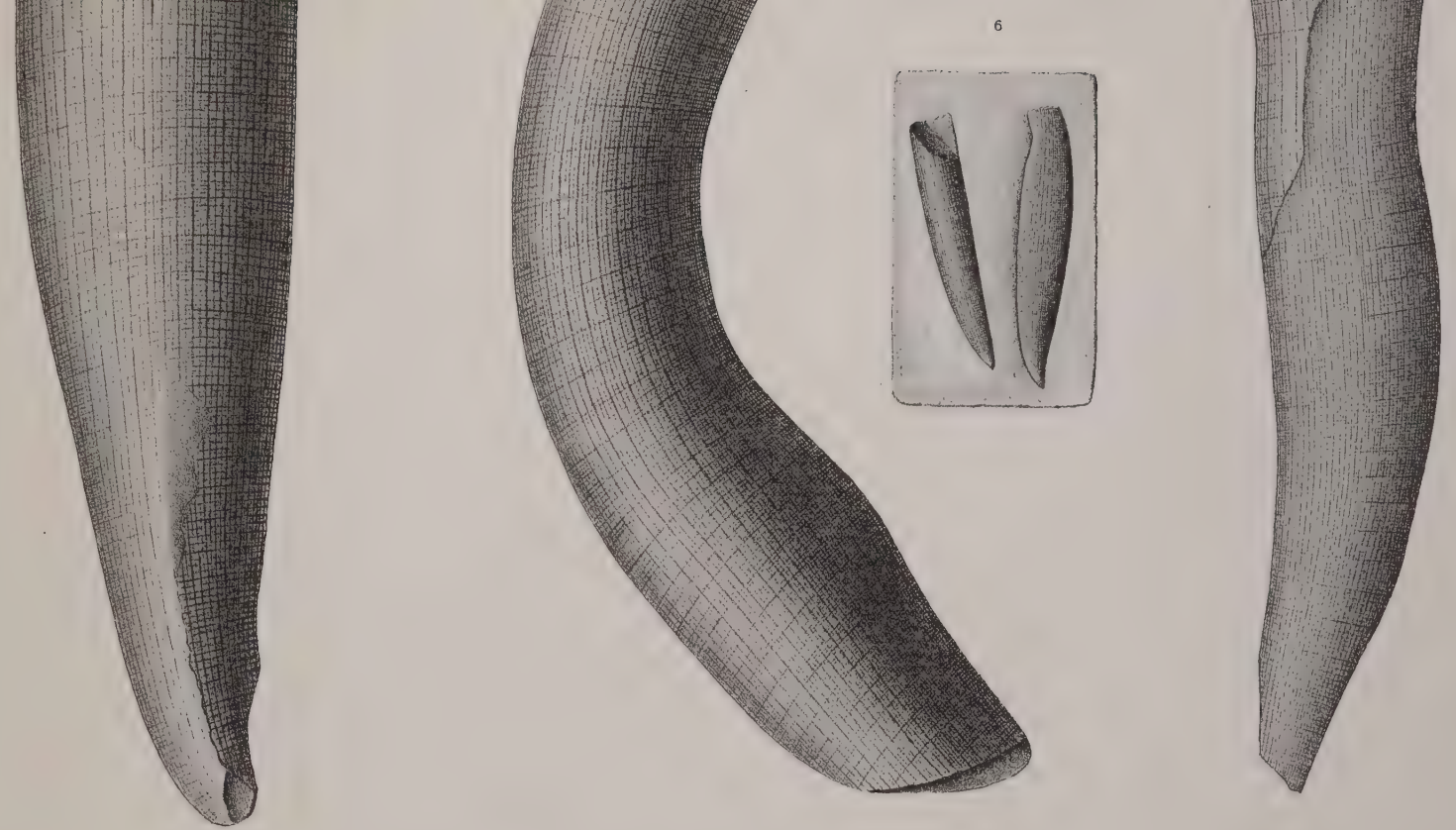


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PLATE XV.

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA EUMORPHA, sp. nov.

Page 815.

Figure 1. A small, entire individual, showing the fine, square meshes of the net-work.

Figure 2. A larger, more elongate and slender example.

Figure 3. A broader cup with the fine reticulation retained over but a part of the surface.

Chemung group. *Wellsville, New York.*

DICTYOSPONGIA CHARITA, sp. nov.

Page 814.

Figure 4. An entire sponge with the basal tuft retained.

Chemung group. *Wellsville, New York.*

DICTYOSPONGIA LOPHURA, sp. nov.

Page 814.

Figure 5. The original specimen, an entire cup showing the elongate rectangular quadrules and the extended basal tuft.

Chemung group. *Wellsville, New York.*

CLATHROSPONGIA, Hall.

Page 861.

(See Plates XIV, XVIII, XXI, XXV, XLIX, L.)

CLATHROSPONGIA (?) IRREGULARIS, Hall (sp.).

Page 864.

Figures 6, 7. Opposite sides of the original specimen; showing the form of the sponge and the character of its reticulation.

Chemung (Portage ?) group. *Ithaca, New York.*

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

Page 813.

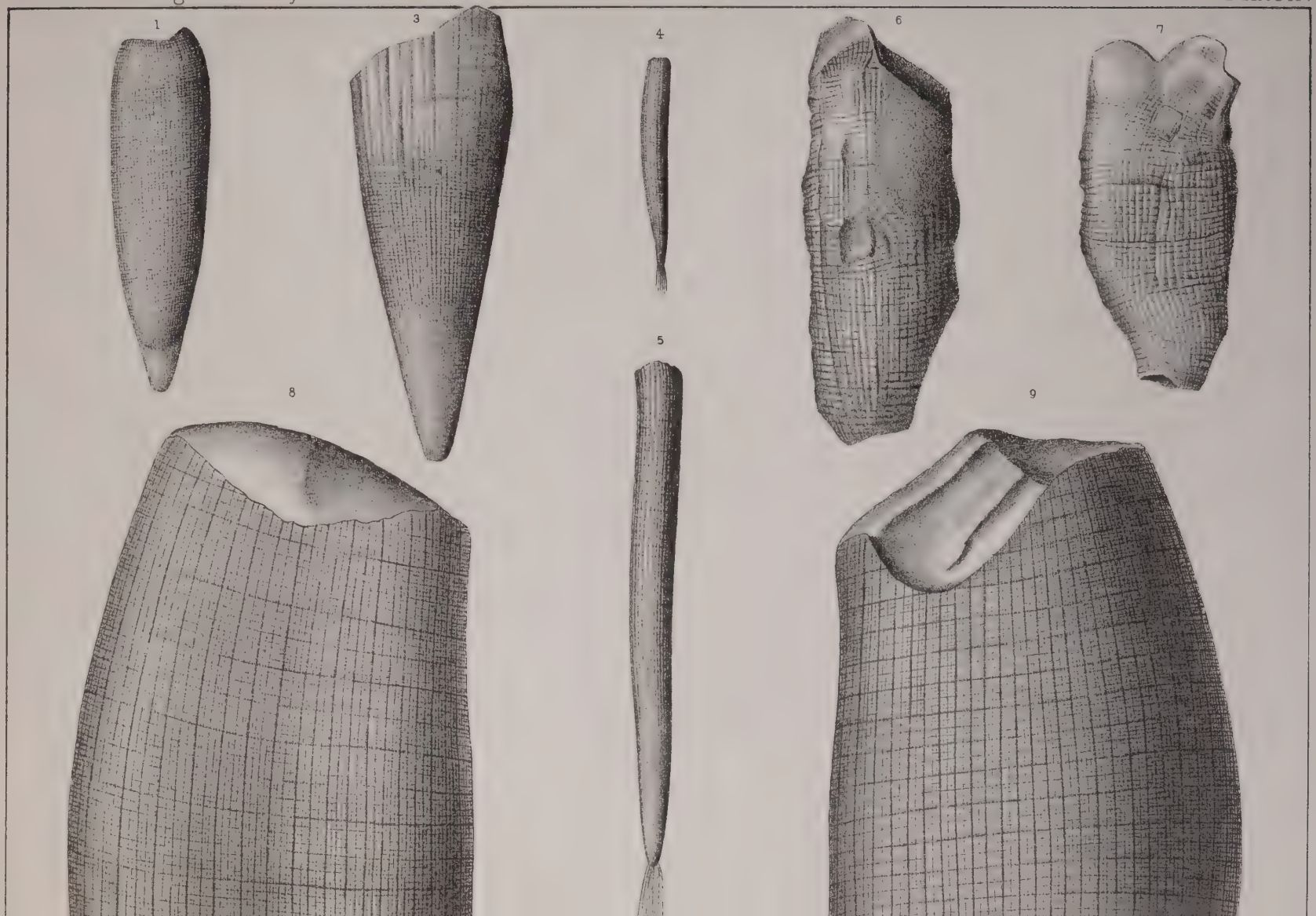
(See Plates XIV, XVI, XXVII, XXXVI.)

Figures 8, 9. Opposite sides of a large, somewhat flattened individual, showing the characteristic surface reticulation.

Chemung group. *Friendship, New York.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York. Plate XV



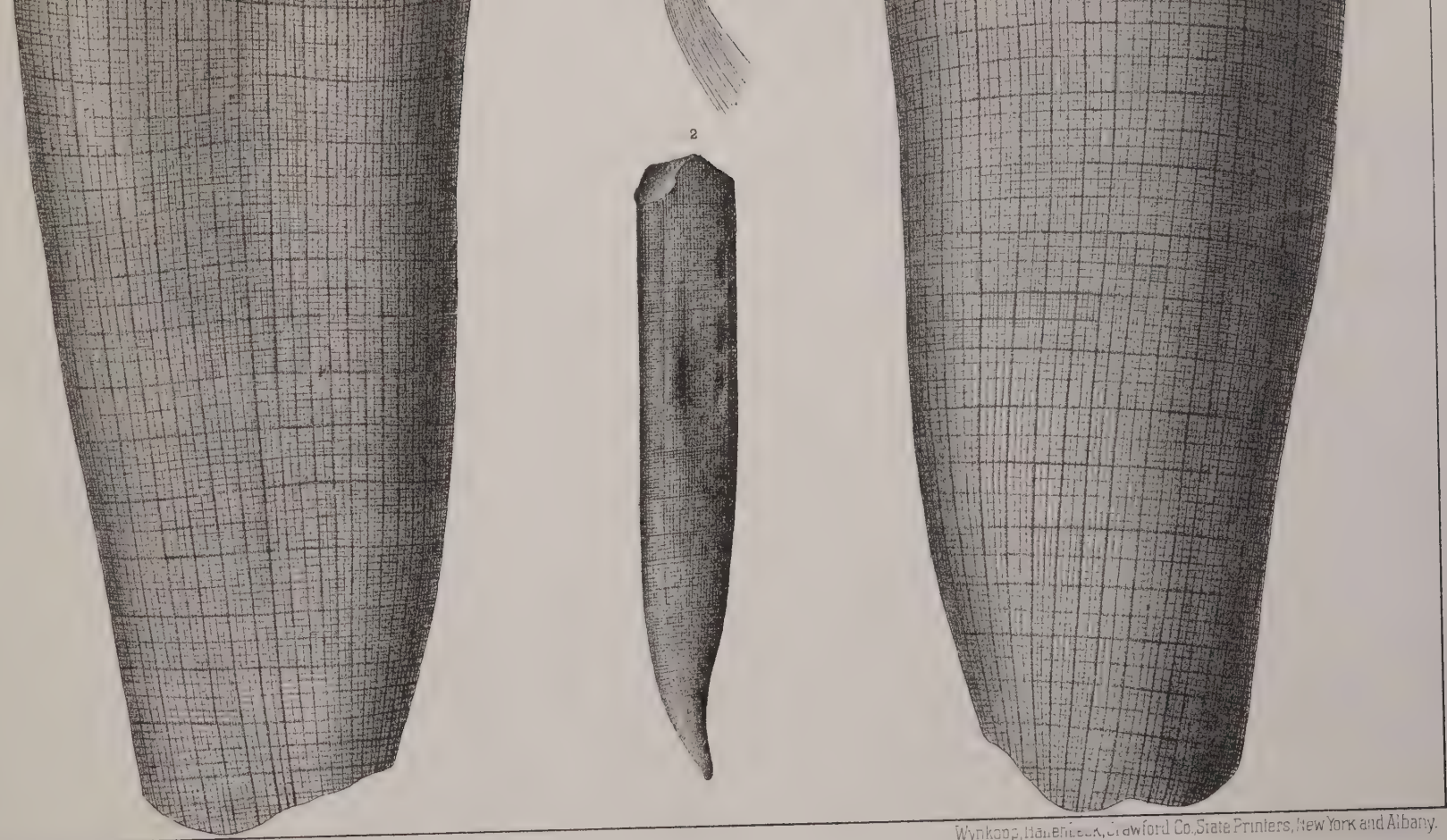


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PLATE XVI.

RHABDOSISPONGIA, gen. nov.

Page 856.

(See Plate XLVII.)

RHABDOSISPONGIA AMALTHEA, Hall (sp.).

Page 856.

Figure 1. A nearly entire individual with broad annulations and sharp vertical ridges. Drawn from a plaster cast of the original specimen which was from the

Chemung group. *Great Bend, Susquehanna county, Pennsylvania.*

HYDRIODICTYA, gen. nov.

Page 817.

(See Plates IV, V, XXI.)

HYDRIODICTYA CYLIX, sp. nov.

Page 818.

(See Plate V.)

Figure 2. The external impression of a large individual somewhat crumpled by compression; showing the prevailing coarse and square meshes of the reticulum. Near the middle of the sponge a break in the net-work has been repaired by highly irregular spicular bands.

Chemung group. *Deyo basin, Naples, New York.*

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XV, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

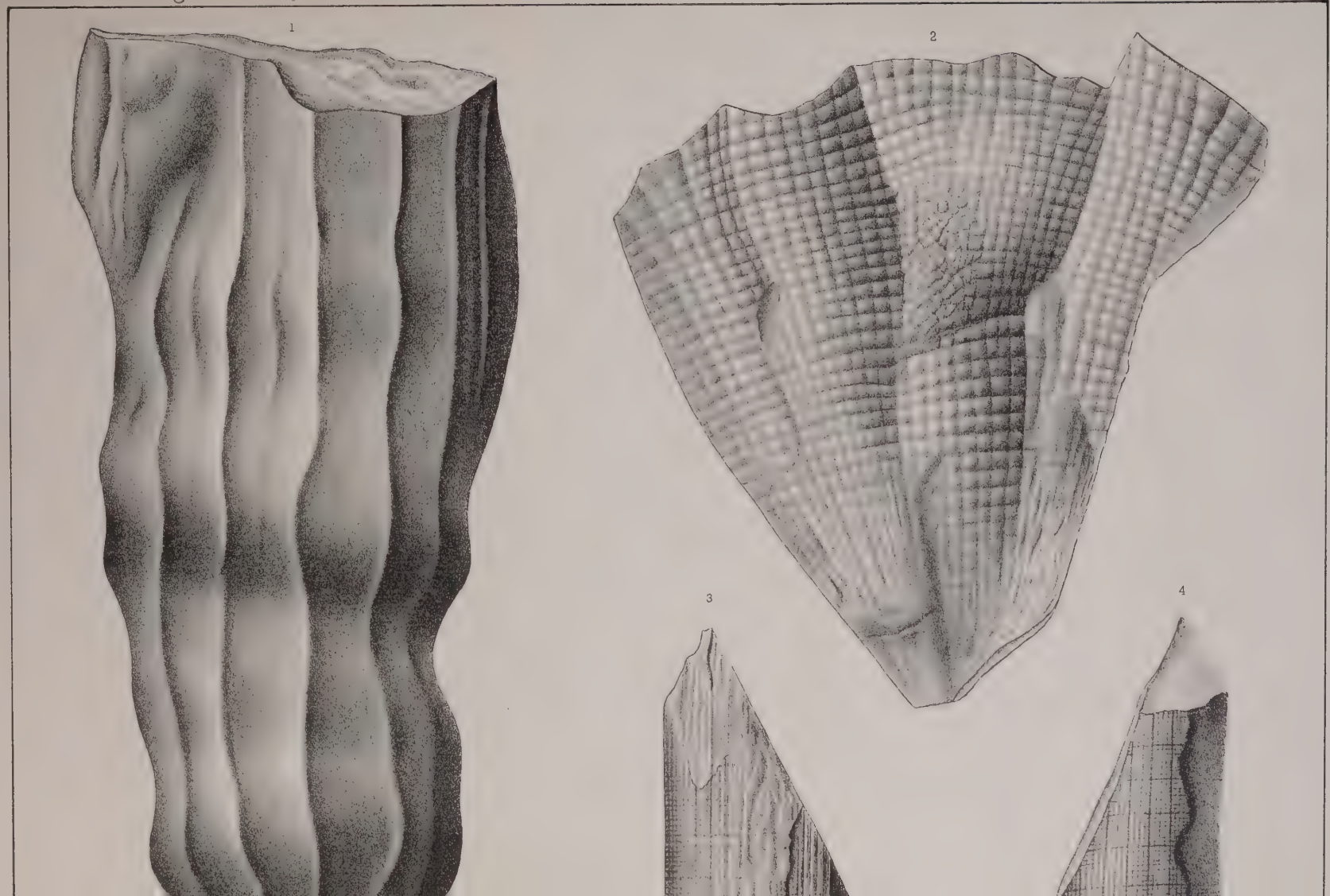
Page 813.

(See Plates XIV, XV, XXVII, XXXVI.)

Figures 3, 4. Opposite sides of a slender but imperfect specimen; showing a difference in the preservation of the reticulum. In figure 4, the exposed side is a sharp internal cast and clearly shows the elongate rectangles produced by the intersection of the primary lamellae, while the surface represented in figure 3 is involved in a muddy or shaly sediment which has retained the finer net-work of the outer wall.

Chemung group. *Friendship, New York.*

DICTYOSPONGIDÆ.



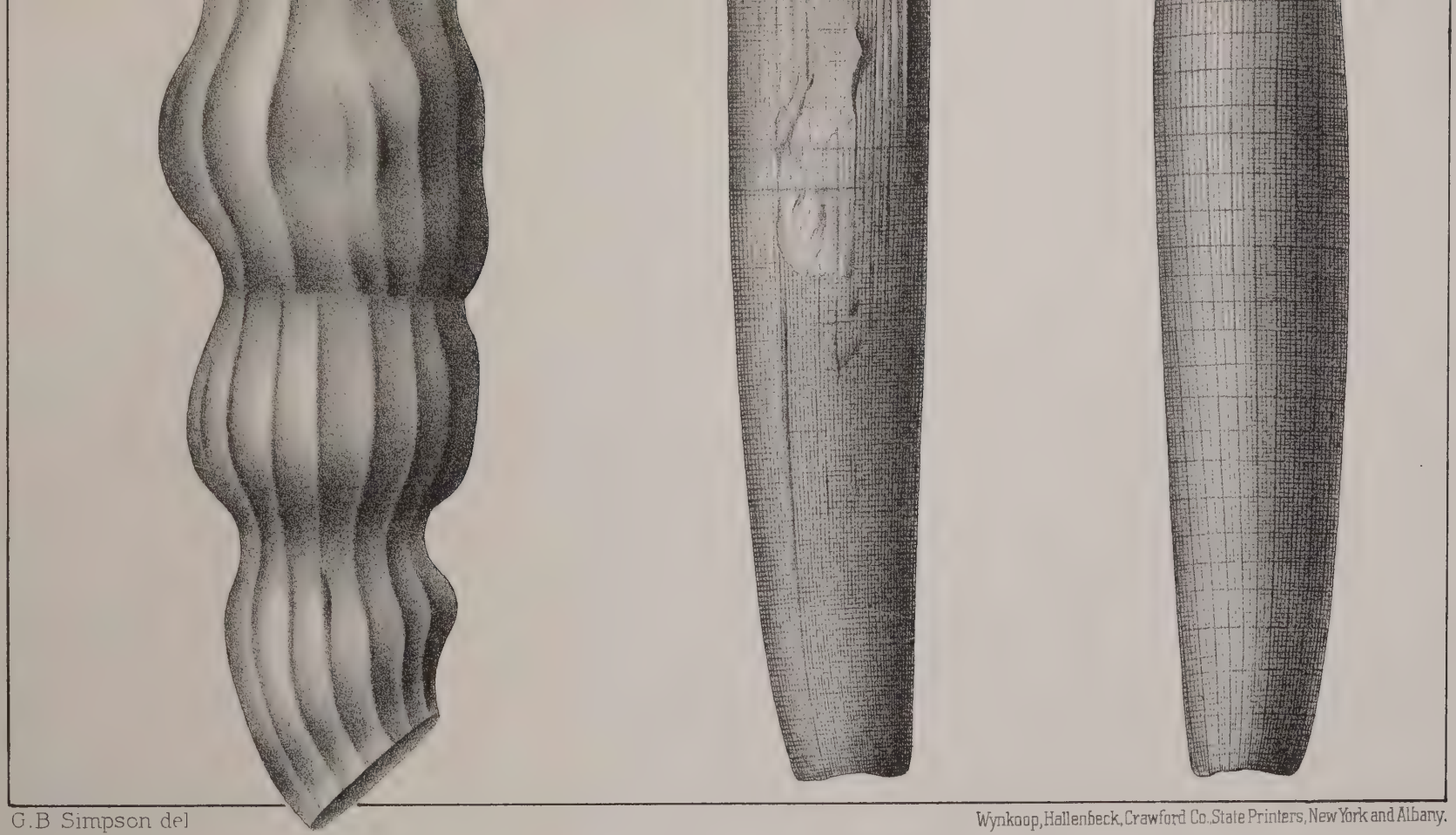


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PLATE XVII.

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA PRISMATICA, Hall (sp.).

Page 823.

(See Plates XXI and XLII.)

Figure 1. An incomplete specimen showing a tendency to spiral growth.
Chemung group. *Wellsville, New York.*

PRISMODICTYA BANANO, sp. nov.

Page 827.

Figure 2. The type-specimen, which is an essentially entire individual of very slender and gracefully tapering form.
Chemung group. *Scio, Allegany county, New York.*

PRISMODICTYA TELUM, Hall (sp.).

Page 820.

(See Plates XXXV and XLII.)

Figure 3. Two individuals, one of them entire and with the normal proportions of the species, the other somewhat imperfect and having a curvature which appears to be the result of natural growth. Both bear casts of spiral vermiform tubes or furrows.

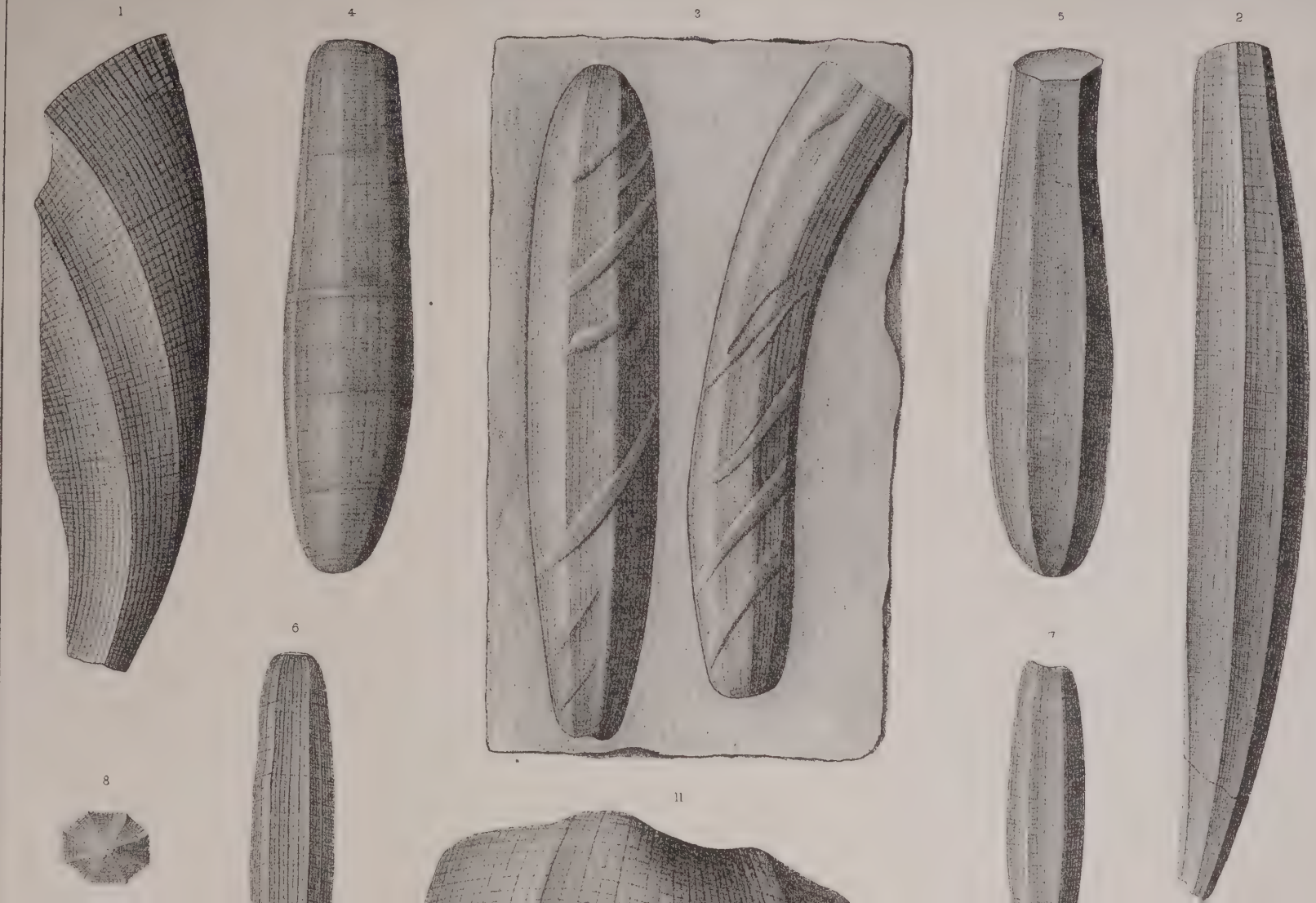
Figures 4, 5. Opposite sides of an entire individual. The surface represented in figure 4, is somewhat worn but shows distant obscure horizontal grooves; that shown in figure 5, is slightly broken at the aperture and has the horizontal grooves represented by sharper reticular furrows.
Chemung group. *Wellsville, New York.*

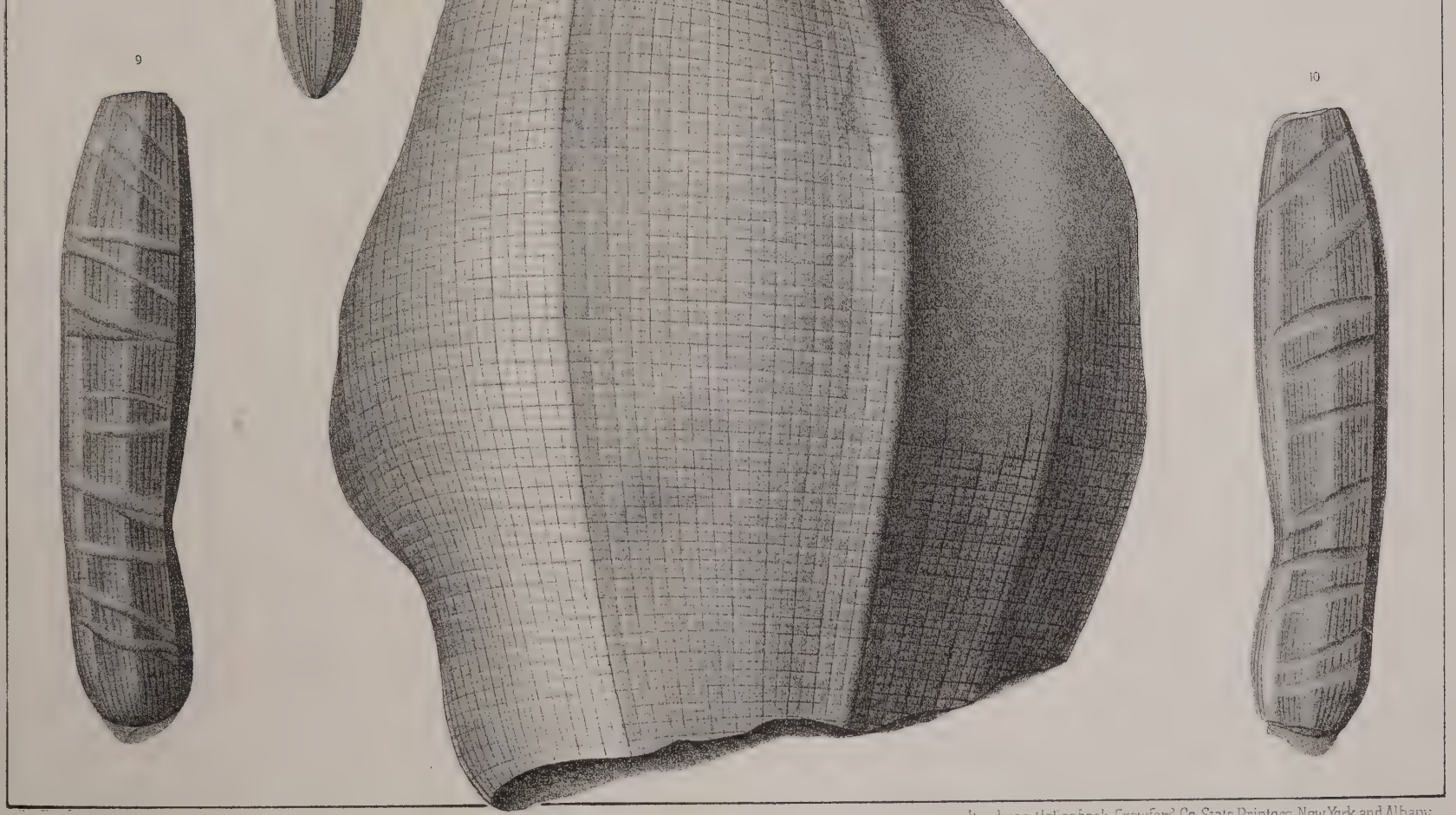
Figure 6. An entire individual of small size and undisturbed proportions, showing the character of the reticulation and the form and size of the aperture. Here as in figures 5 and 7, the prism-faces are made to appear somewhat too concave.

Figure 8. Basal view of the same specimen.
Chemung group. *Cattaraugus county, New York.*

Figure 7. A small entire example.

DICTYOSPONGIDÆ.





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Figures 9, 10. Opposite sides of an entire specimen showing the marks of encircling or spiral tubes, probably made by a commensal annelid. On one side of the specimen (fig. 9) these are preserved as ridge-like casts and on the other (fig. 10) as furrows.

The specimens represented in figures 3, 4, 5, 7, 9 and 10 are from a single slab crowded with individuals of this species.

Chemung group. *Wellsville, New York.*

PRISMODICTYA CORYNIA, sp. nov.

Page 826.

Figure 11. The upper portion of a very large sponge with broadly expanded prism-faces and a coarse square reticulation.

Chemung group. *Wellsville, New York.*

PLATE XVIII.

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA BACULUM, Hall (sp.).

Page 821.

Figures 1, 2. Opposite sides of an incomplete sponge which is referred to this species.

Chemung group. *Alfred, New York.*

Figure 3. The type-specimen, an incomplete cup, slender near the base and expanded toward the aperture. The specimen is a sharp internal cast, showing the regularity of the primary reticulation.

Chemung group. *Wellsville, New York.*

PRISMODICTYA CONRADI, Hall (sp.).

Page 831.

(See Plate XIX.)

Figure 4. Lateral view of the original specimen; showing the regularly expanding form, the character of the reticulation and, over the upper part of the sponge, the somewhat irregular tendency to the formation of nodes upon the prism-faces.

Chemung group. *Randolph, Cattaraugus county, New York.*

CLATHROSPONGIA, Hall.

Page 861.

(See Plates XIV, XV, XXI, XXV, XLIX, L.)

CLATHROSPONGIA (?) TOMACULUM, Hall (sp.).

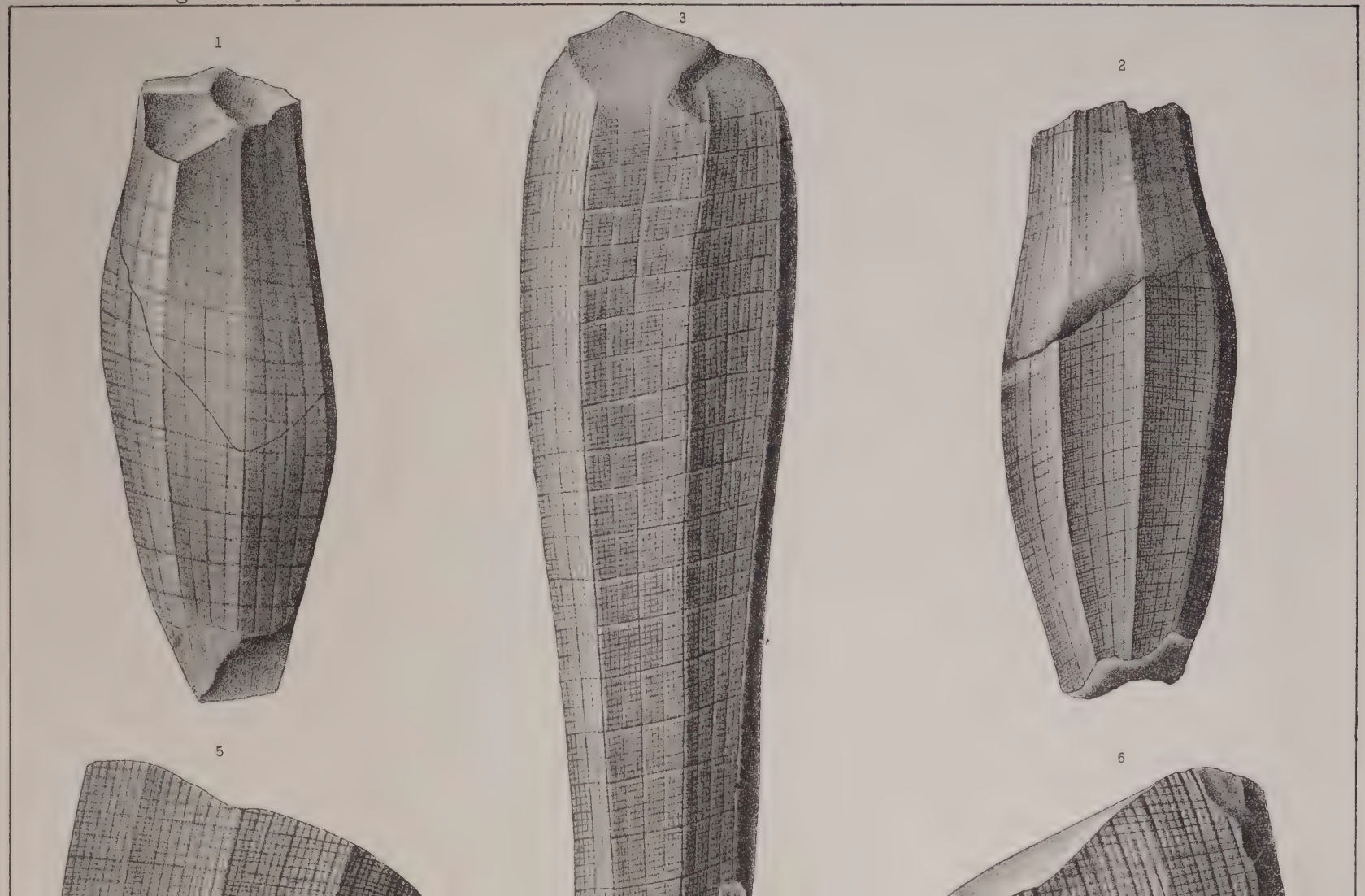
Page 863.

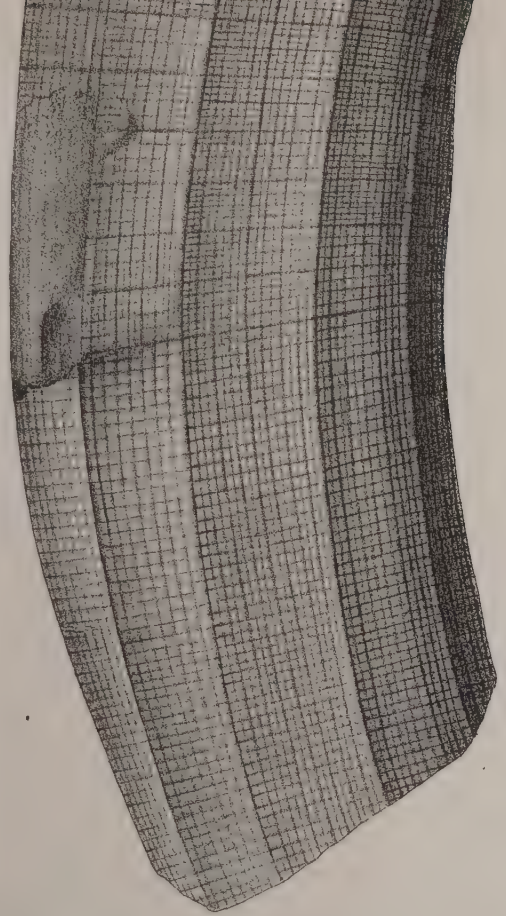
(See Plate XXI.)

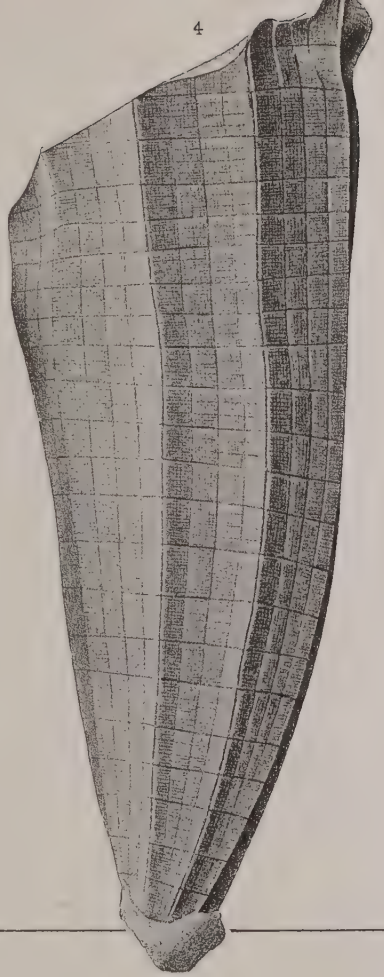
Figures 5, 6. Opposite sides of the type-specimen, which is a portion of a large, very gradually expanding sponge with low and narrow prism-faces. The reticulation is coarse and over most of the exposed surfaces shows a prevalence of square meshes. The curvature of the specimen is probably accidental.

Chemung group. *Alfred, New York.*

DICTYOSPONGIDÆ.







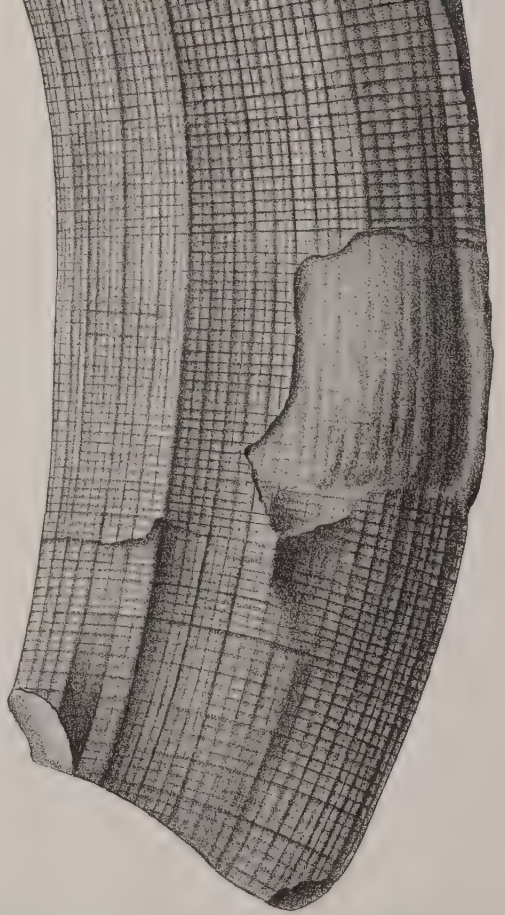


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PLATE XIX.

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA CHOANEA, sp. nov.

Page 825.

(See Plates XXVII and XXXV.)

Figure 1. The basal portion of a specimen of medium size, showing a fine reticulum and faint traces of prism-faces.

Figure 2. A similar portion of a larger specimen.

Chemung group. *Ischua, Cattaraugus county, New York.*

Figure 3. The upper portion of a large cup, believed to represent this species; having the prism-faces obsolescent and an extremely fine reticulum. This specimen is accompanied by fragments of others of the same species and impressions of the brachiopod, *Spirifer disjunctus.*

Chemung group. *Almond, Allegany county, New York.*

PRISMODICTYA PARALLELA, Hall (sp.).

Page 822.

(See Plates XX, XXI, XXXV.)

Figure 4. The exterior of a portion of a cup, showing its gradual expansion, the somewhat obscure and rounded prism-faces and the sharply elevated primary reticular bands. This is drawn from a plaster-cast of the original specimen, which is an external impression in sandstone.

Chemung group. *Southwestern New York (precise locality unknown).*

PRISMODICTYA CONRADI, Hall (sp.).

Page 831.

(See Plate XVIII.)

Figure 5. An apical view of the basal extremity of the specimen shown on plate 18, figure 4.

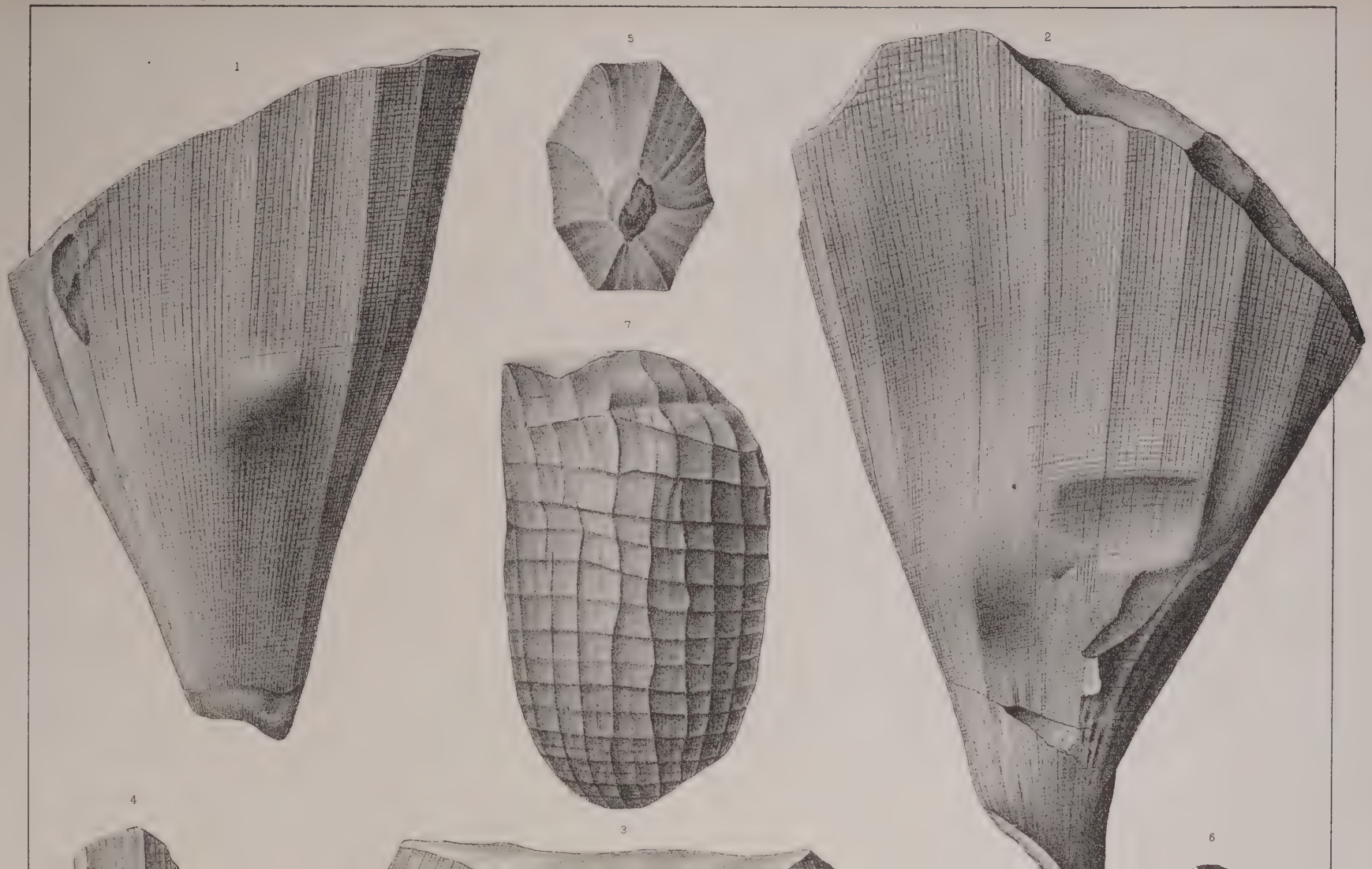
Figure 6. Side view of the same specimen presenting its narrower diameter and showing the irregular node at the top.

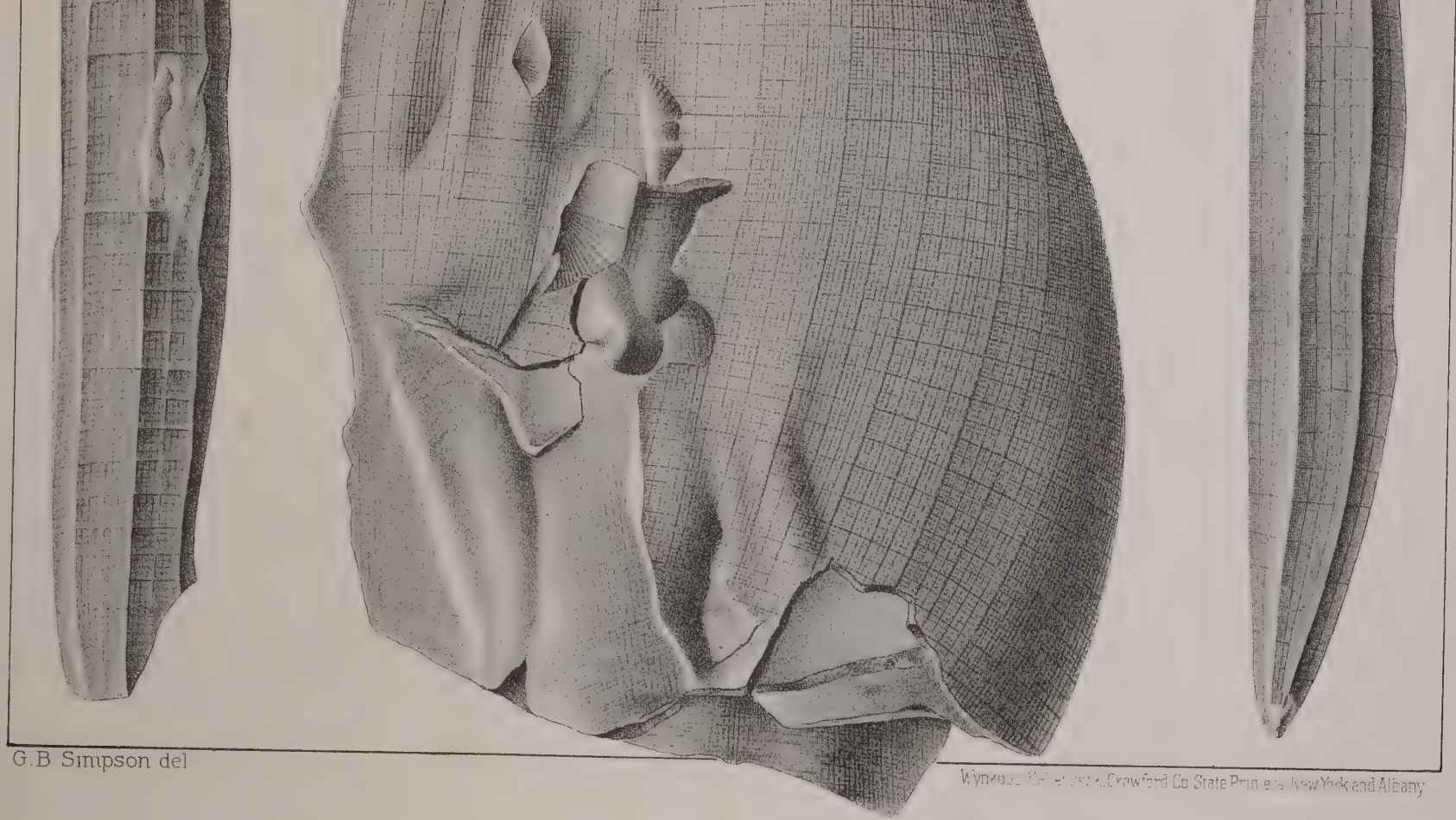
Chemung group. *Randolph, Cattaraugus county, New York.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate XIX.





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THYSANODICTYA, gen. nov.

Page 865.

(See Plates XXIII, XXIV, XXV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA RUDIS, Hall (sp.).

Page 868.

(See Plate XXIII.)

Figure 7. A fragment of a cup showing the coarse, square primary spicular bands and the very fine subordinate reticulation.

Chemung group. *Wellsville, New York.*

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PLATE XX.

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XIX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA CERCIDEA, sp. nov.

Page 829.

(See Plate XLII.)

Figure 1. An entire flattened, though symmetrical specimen, with subequal extremities. It is possible that the spot at the lower end may represent the aperture and the specimen have thus been drawn in an inverted position, but this is uncertain as the margins of this spot are not so clearly defined as here represented and the other extremity is not fully uncovered.

Figures 2, 3. Opposite sides of another example which has been obliquely compressed.

Chemung group. *Wellsville, New York.*

PRISMODICTYA ALLEGANIA, sp. nov.

Page 824.

Figure 4. A fragment of a very large individual showing the upward expansion of the sponge, the median division of the prism-faces and the fine reticulation.

Chemung group. *Scio, New York.*

PRISMODICTYA SPECTABILIS, sp. nov.

Page 822.

Figure 5. A nearly entire specimen representing a fine sponge, which attains its greatest expansion shortly above the base and is regularly prismatic for the rest of its extent. The prism-faces are not developed near the base of the cup, although thus represented in the lithograph, but the surface about the apex is smooth and round for a considerable distance.

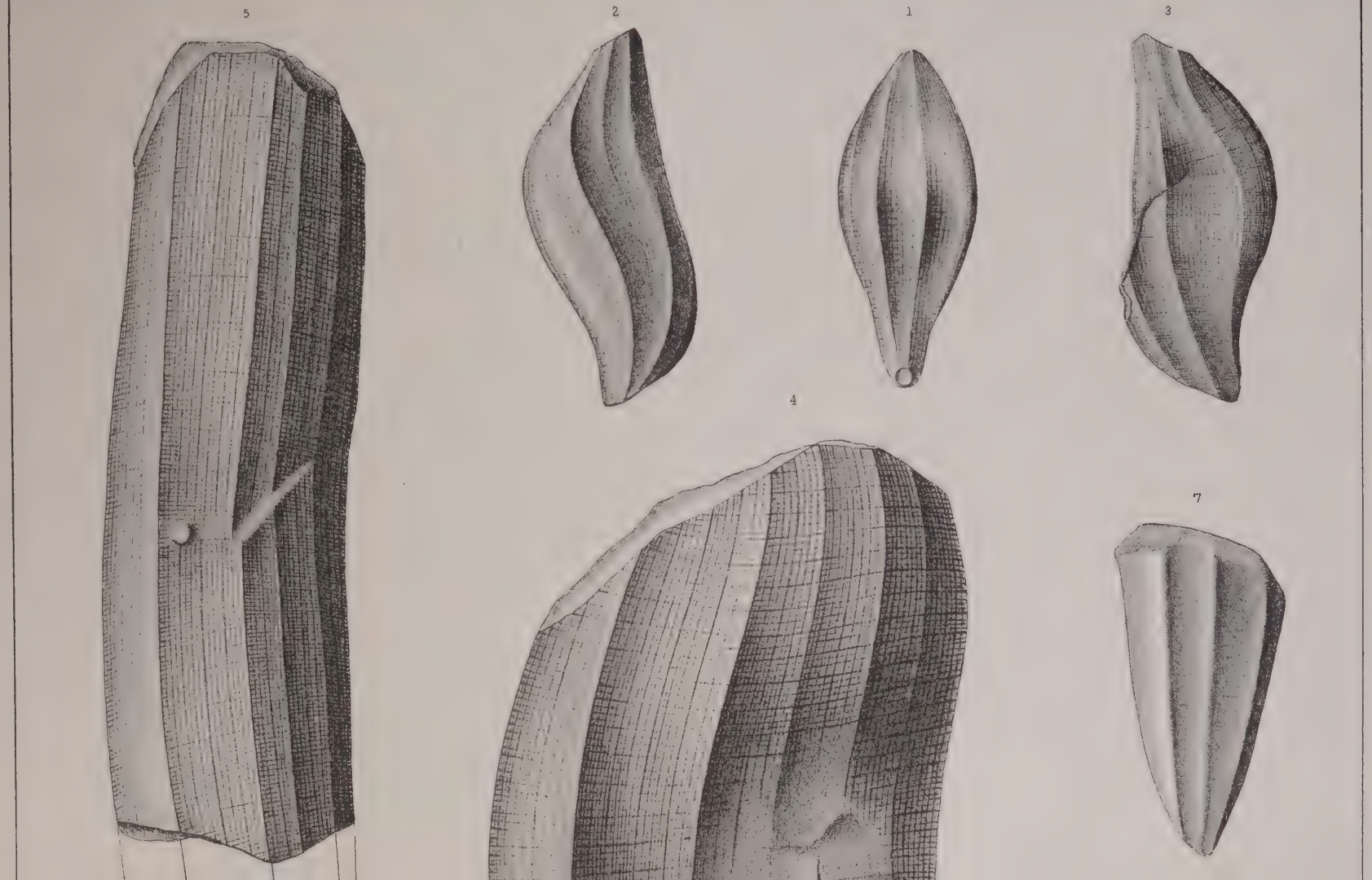
Chemung group. *Wellsville, New York.*

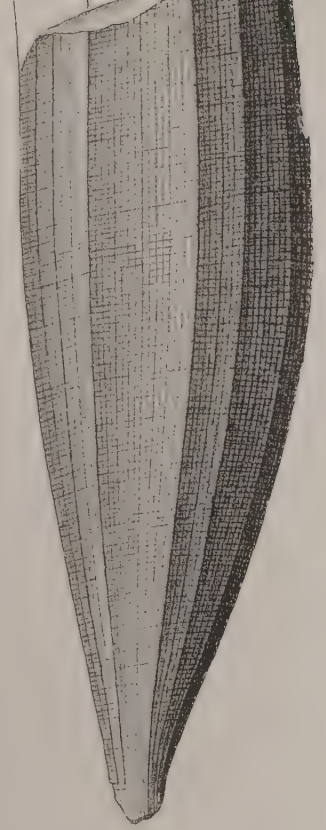
PRISMODICTYA PARALLELA, Hall (sp.).

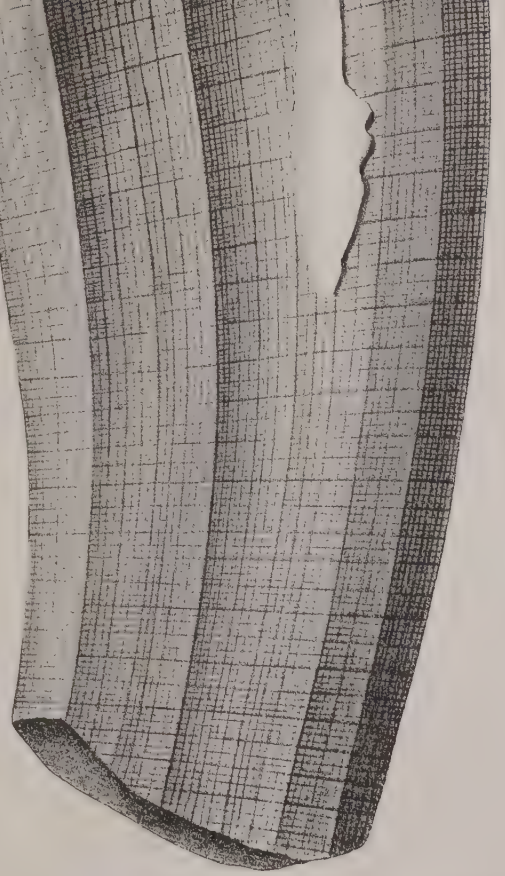
Page 822.

Figure 6. Transverse section of an uncompressed specimen.

DICTYOSPONGIDÆ.







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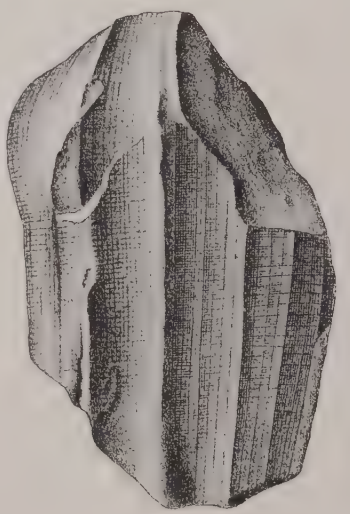

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PRISMODICTYA AULOPHIA, sp. nov.

Page 828.

(See Plates XXXIV and XLI.)

Figure 7. The basal portion of a weathered specimen; showing the concave prism-faces.

Figure 8. A fragment of the median portion of a specimen; showing the concave prism-faces and the extremely fine surface reticulation.

Chemung group. *Wellsville, New York.*

PLATE XXI.

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XIX, XX, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA PRISMATICA, Hall (sp.).

Page 823.

(See Plates XVII and LXII.)

Figure 1. The apertural end of an average specimen; showing the slight contraction toward the margin.

Figure 2. A portion of a small and very slender example.

Figure 3. A portion of an individual having a tendency to spiral growth.

Figure 4. A nearly entire individual of average size.

Figure 5. An enlargement of the surface of an internal cast; showing the character of the reticulation and the rows of depressions on the prism-angles at their intersection with the principal horizontal spicular bands. Such pits probably represent the bases of spicular tufts.

Figure 6. Another internal cast also showing vertical rows of pits.
Chemung group. *Concord station, Erie county, Pennsylvania.*

PRISMODICTYA FILITEXTILIS, Hall (sp.).

Page 826.

(See Plate XXVII.)

Figure 7. A gutta-percha squeeze of the original specimen which is an external cast showing a fine reticulum and very obscure prism-faces.
Chemung group. *Steuben county, New York.*

PRISMODICTYA PARALLELA, Hall (sp.).

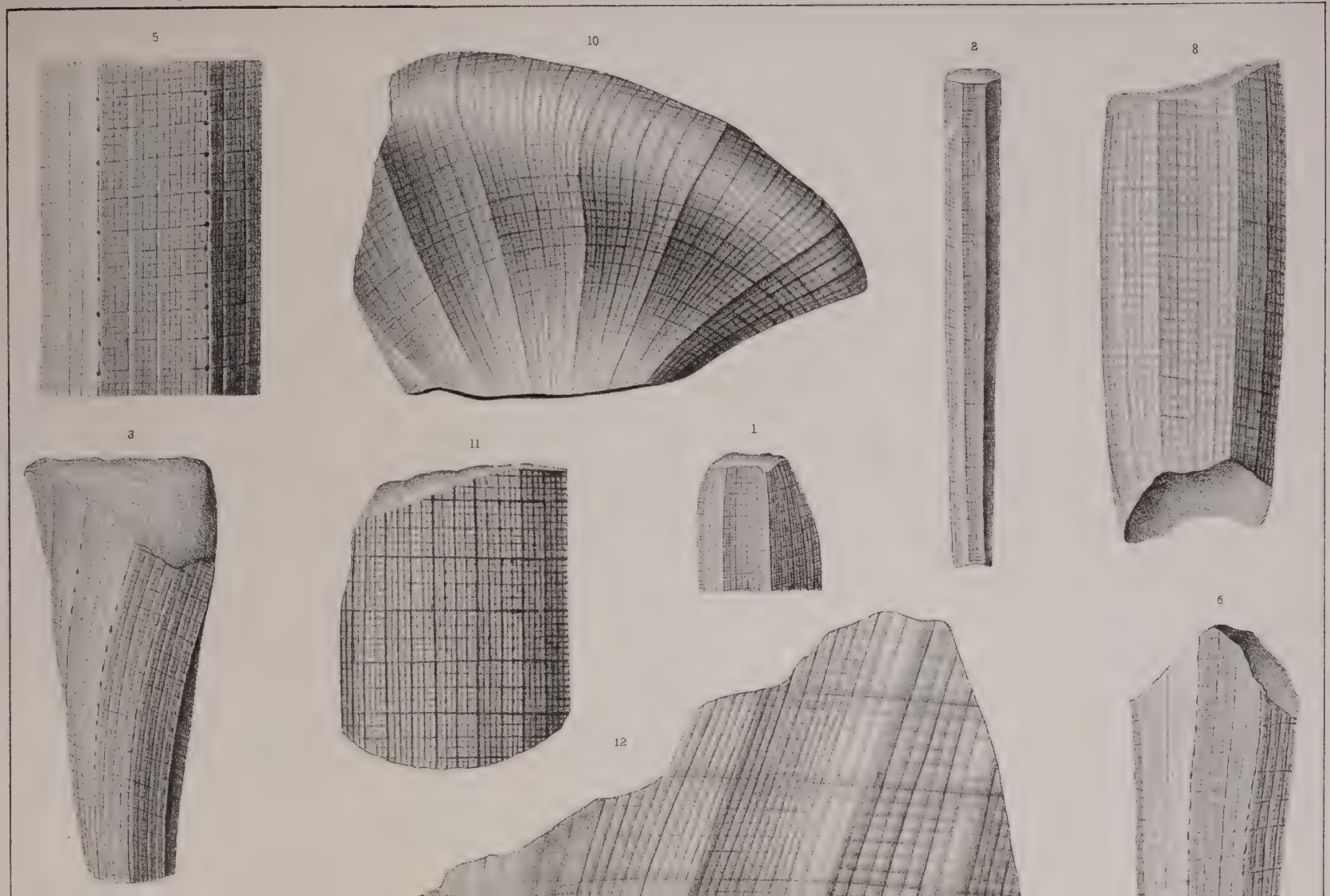
Page 822.

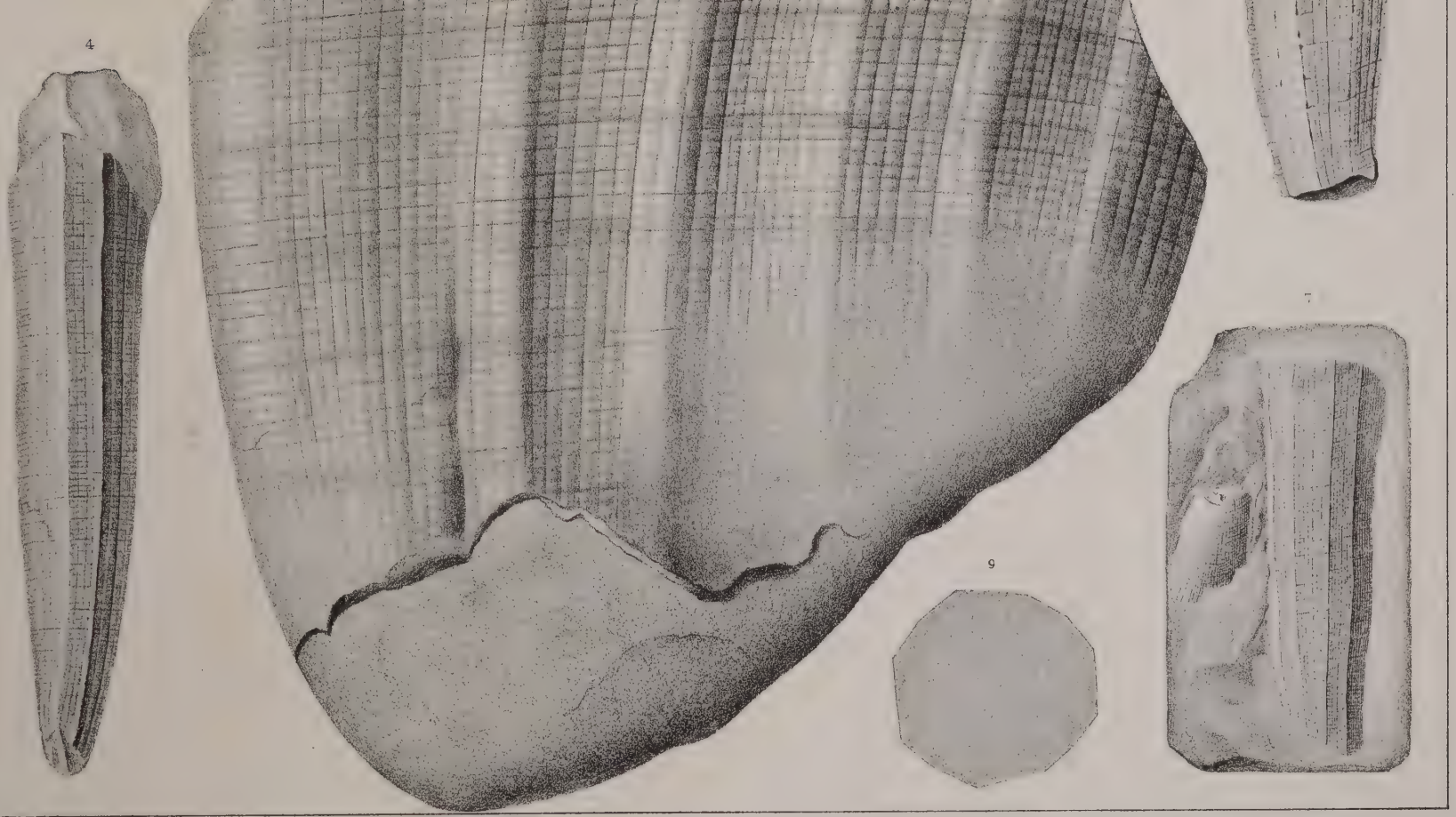
(See Plates XIX and XXXV.)

Figure 8. A fragment of a rather large, uncompressed specimen.

Figure 9. Transverse section of the same example.
Chemung group. *Wellsville, New York.*

DICTYOSPONGIDÆ.





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HYDRIODICTYA, gen. nov.

Page 817.

(See Plates IV, V, XVI, LV.)

HYDRIODICTYA NEPHELIA, sp. nov.

Page 819.

Figure 10. An incomplete specimen showing what appears to be the expanded apertural part of a vase-shaped cup with subprismatic faces.

Cemung group. *Scio, New York.*

CLATHROSPONGIA, gen. nov.

Page 861.

(See Plates XIV, XV, XVIII, XXI, XXV, XLIX, L.)

CLATHROSPONGIA (?) TOMACULUM, Hall (sp.).

Page 863.

(See Plate XVIII.)

Figure 11. A sharply defined cast of a portion of the exterior showing the character of the quadrulation.

Chemung group. *Alfred, N Y.*

CLATHROSPONGIA VASCELLUM, Hall (sp.).

Page 863.

(See Plate XXV.)

Figure 12. The opposite side of the specimen shown on the plate cited. This surface exhibits traces of very coarse primary vertical spicular ridges and in places shows some of the finer reticulation.

Chemung group. *Alfred, N. Y.*

PLATE XXII.

HELICODICTYA, gen. nov.

Page 854.

(See Plate XXVII.)

HELICODICTYA TRYPANIA, sp. nov.

Page 854.

Figure 1. Lateral view of a compressed specimen, showing the spiral ridges parallel to one of the rectangularly reticulating spicular series.

Figure 2. The same specimen with the lower portion removed to show the continuity of the spiral ridges on the impression of the opposite side.

Chemung group. *Wellsville, New York.*

CERATODICTYA, gen. nov.

Page 857.

(See Plates XLI, XLII, XLIII.)

CERATODICTYA ANNULATA, Hall (sp.).

Page 860.

Figures 3, 4. Opposite sides of a large specimen with broad and low annulations.

Chemung group. *Deyo basin, Naples, New York.*

Figure 5. The original figure of the species, showing five short and subequal annulations.

Figure 6. Another view of the same specimen.

Chemung group. *Western New York (precise locality lost).*

CERATODICTYA CINCTA, Hall (sp.).

Page 858.

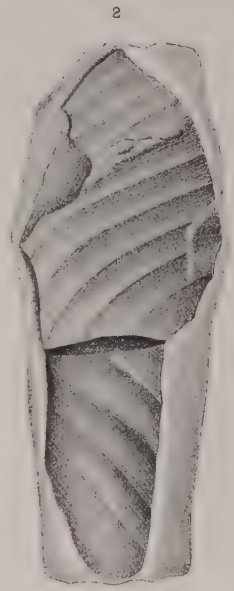
Figure 7. One side of the original specimen, showing below the disordered and interrupted growth of the annulations.

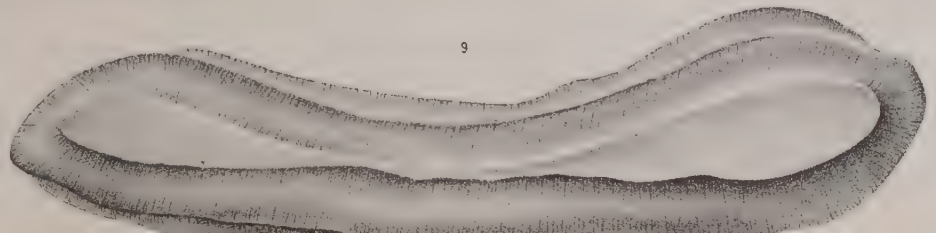
Figure 8. The opposite side of the same fragment, the growth of the annulations here being regular and undisturbed.

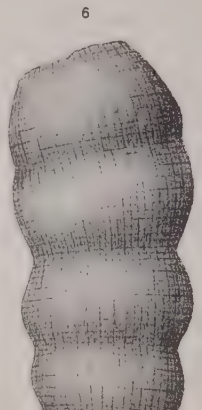
Figure 9. An end view of the specimen, showing the compression to which it has been subjected.

Chemung group. *From a boulder at Erie, Pennsylvania.*

DICTYOSPONGIDÆ.







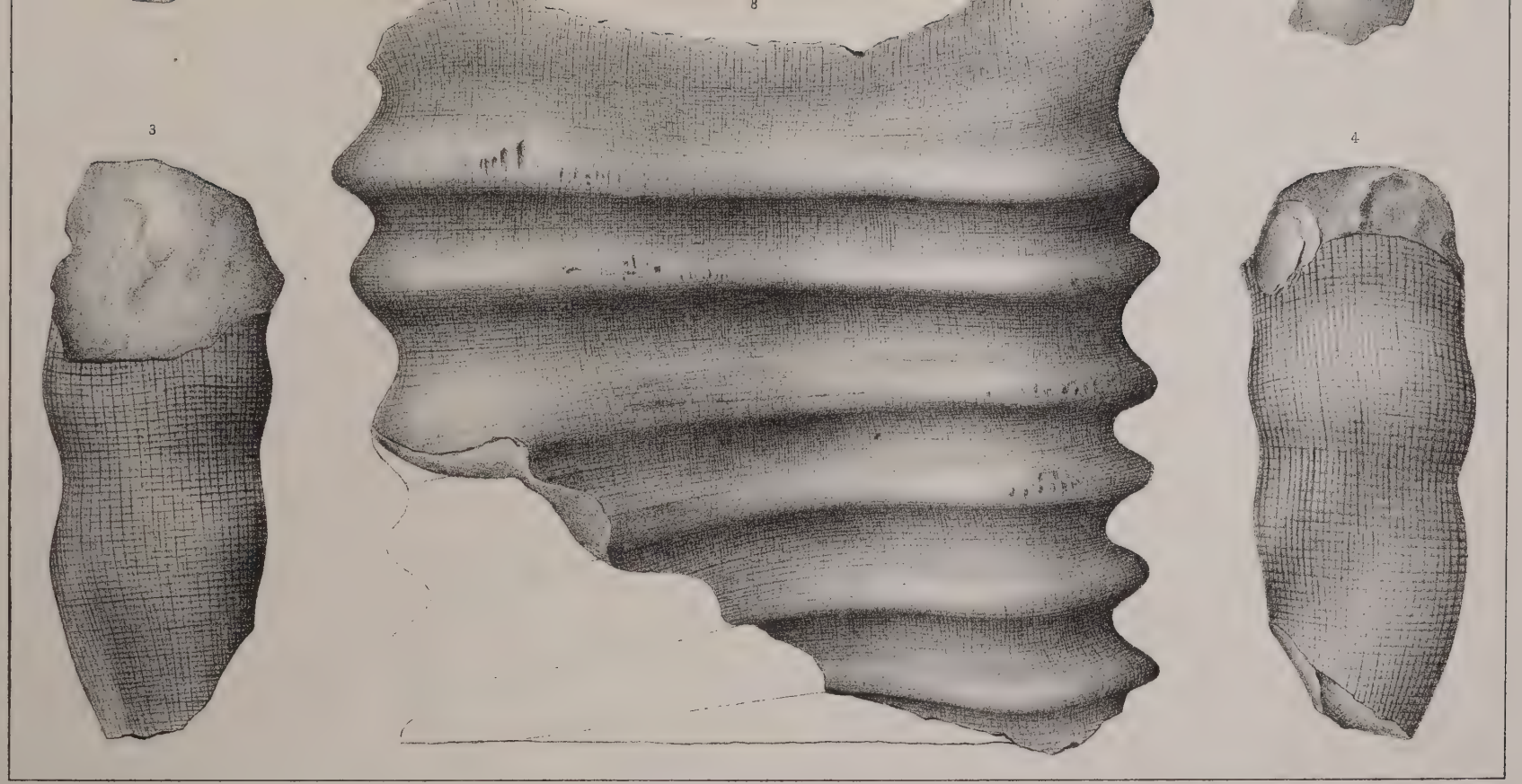


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PLATE XXIII.

THYSANODICTYA, gen. nov.

Page 865.

(See Plates XIX, XXIV, XXV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA RUDIS, Hall (sp.).

Page 868.

(See Plate XIX.)

Figure 1. An essentially entire individual, showing the form of the aperture, the cylindrical body and coarse and fine reticulation.
Chemung group. *Ischua, Cattaraugus county, New York.*

Figure 2. A basal disk, probably of this species, showing the excentric apex, the concentric and apparently radial striae.
Chemung group. *Alma, Allegany county, New York.*

Figure 3. A portion of a specimen believed to be of this species; showing differences in the preservation of the reticulum on various parts of the surface.

Figure 4. The opposite side of the same specimen lying in its matrix and showing the projection of both vertical and horizontal erect lamellae.

Figure 5. Basal view of this specimen.
Chemung group. *Wellsville, New York.*

Figure 6. The original specimen of this species, which is a nearly entire individual showing the form and size of the primary quadrules and a part of the finer reticulation.
Chemung group. *Little Genesee, Allegany county, New York.*

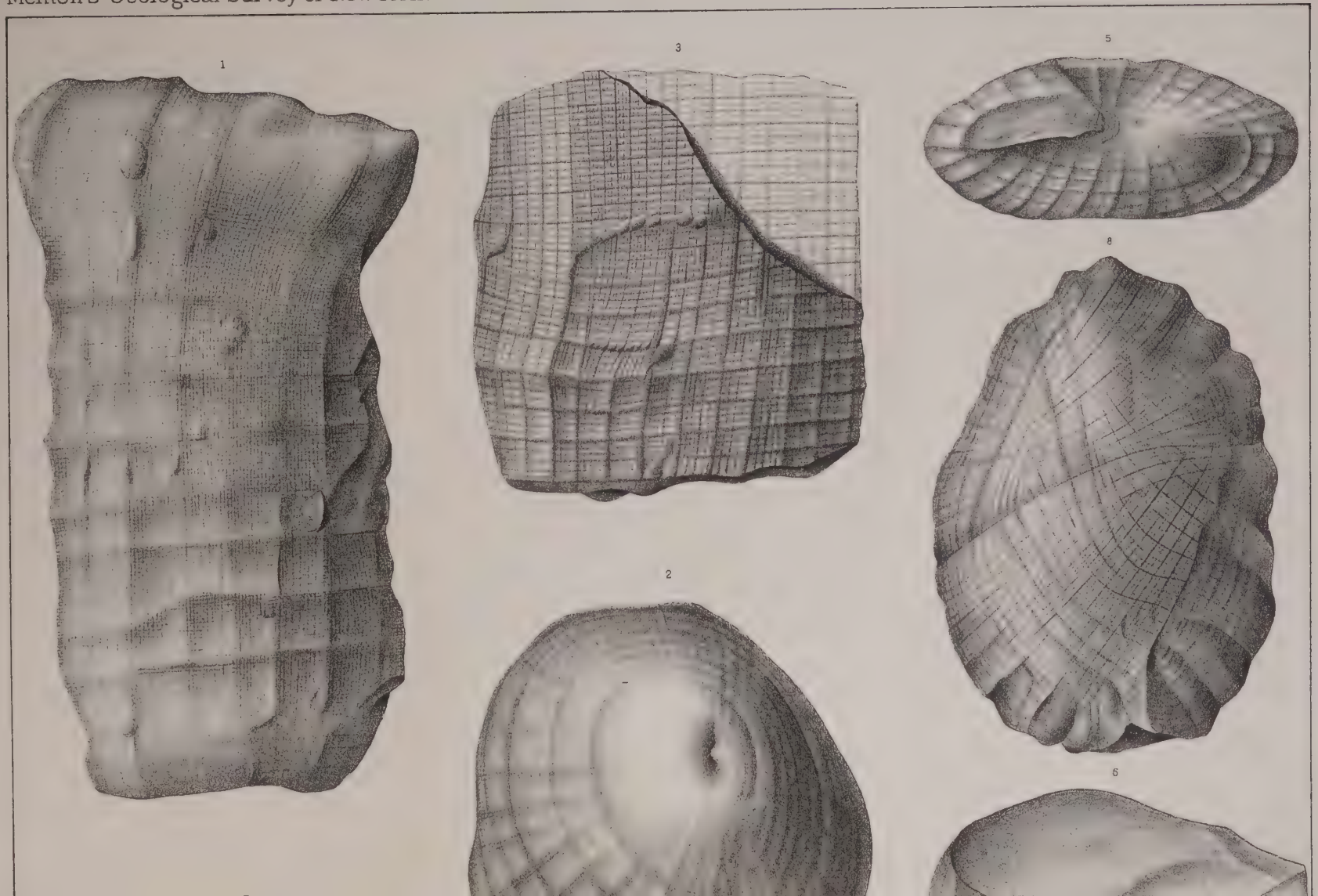
THYSANODICTYA JOHNSTONI, sp. nov.

Page 870.

Figure 7. An entire specimen, bent upward at the base. The body of the cup is covered with low nodes of shaly matter which appears to have formed in a concretionary manner about irregularities or projections upon the surface of the reticulum. The character of the basal disk, its eccentric apex and nodose periphery are well known.

Figure 8. A basal disk with a highly irregular reticulum and without defined apex. This appears to be a normal and not accidental condition.
Chemung group. *Wellsville, New York.*

DICTYOSPONGIDÆ.



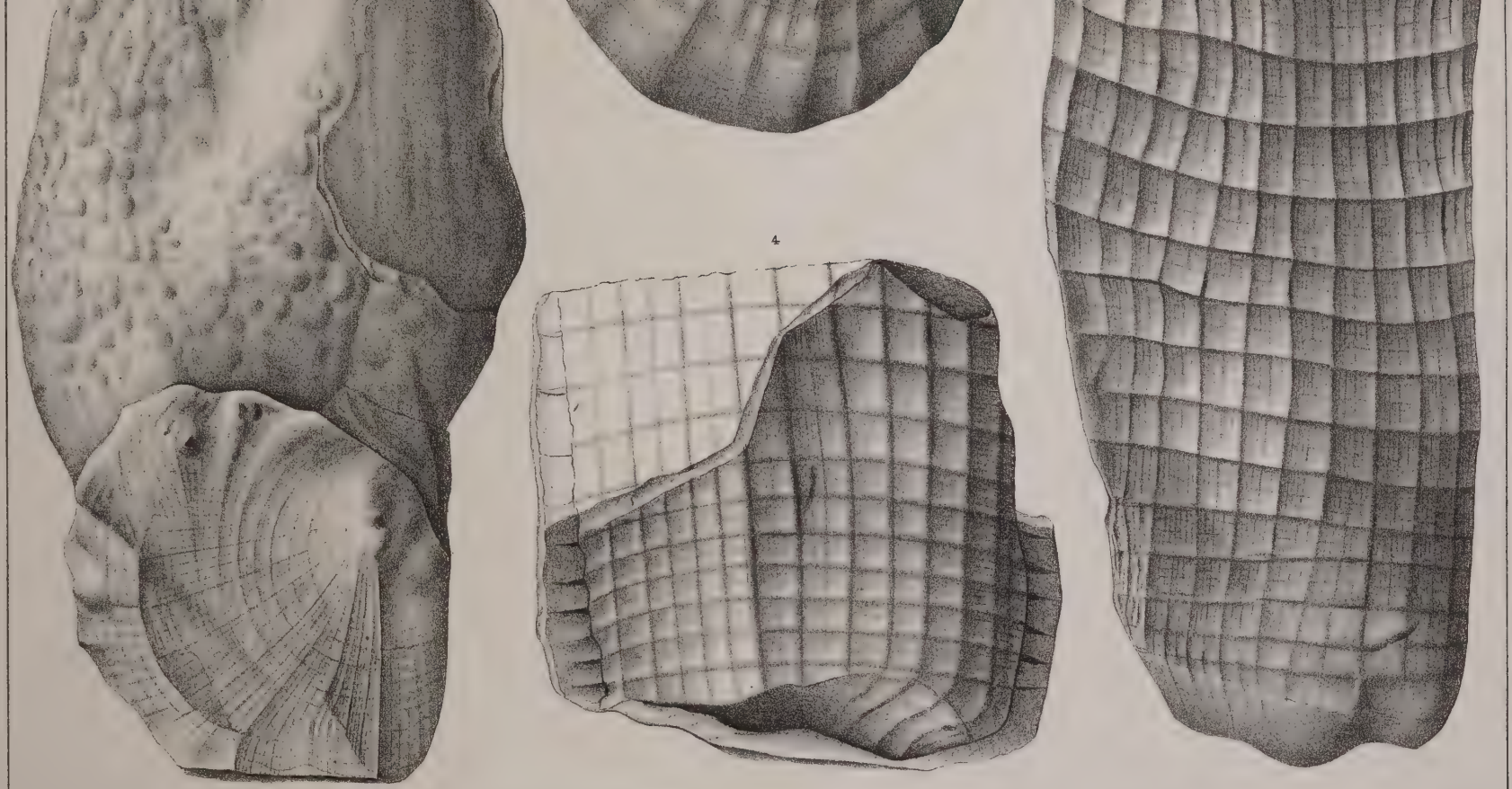


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PLATE XXIV.

THYSANODICTYA, gen. nov.

Page 865.

(See Plates XIX, XXIII, XXV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA EDWIN-HALLI, nom. nov.

Page 866.

Figures 1, 2. Opposite sides of a nearly entire cup of average size; showing the broad, oblique aperture, the basal disk and the coarse primary reticulation.

Figure 3. A much more slender specimen, showing both the primary and subordinate reticulation.

Figure 4. A portion of the surface of another specimen, showing primary and secondary reticulation.

Figure 5. A small specimen exposing a part of the basal disk.

Figure 6. The lower portion of a specimen, showing the basal disk.

Figure 7. A view of the same specimen lying in its matrix and showing the broad frill at the periphery of the basal disk.

Figure 8. A flattened but essentially entire sponge in which only the strong primary quadrules are shown.

Figure 9. An incomplete specimen showing the finer reticulation. When preserved in this condition these specimens are hardly to be distinguished from internal casts of *Clathrospongia abacus* (see Plate 49, figure 8). Chemung group. *Wellsville, New York.*

THYSANODICTYA PŒCILUS, sp. nov.

Page 867.

Figure 10. A very elongate individual, having the prevailing form of the primary quadrules nearly square; showing, also, some of the tufted intersections of the erect surface lamellae.

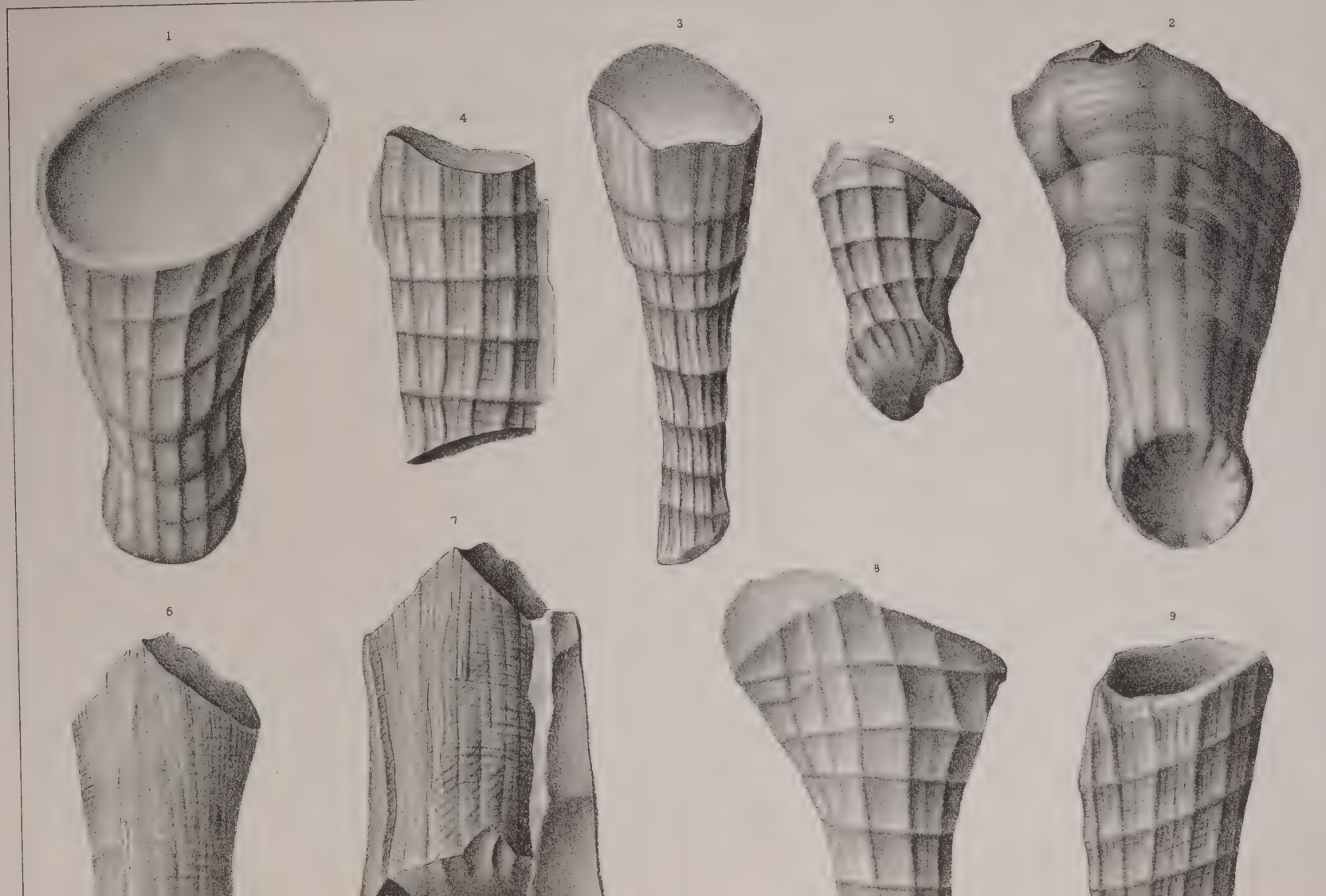
Figure 11. A broader individual, showing the complete outline of the body of the sponge, its aperture and base and the strong erect vertical lamellae and their intersections with similar horizontal lamellae. At the base, on one side, a portion of the basal frill is retained. Both this and the preceding specimen are preserved on the same slab in association with other forms less complete but showing less extreme outlines.
Chemung group. *Scio, Allegany county, New York.*

THYSANODICTYA RANDALLI, Hall (sp.).

Page 869.

Figure 12. A view of the original specimen which is a fragment of the upper portion of a cup showing the character of the reticulation.
Chemung group. *Warren, Pennsylvania.*

DICTYOSPONGIDÆ.



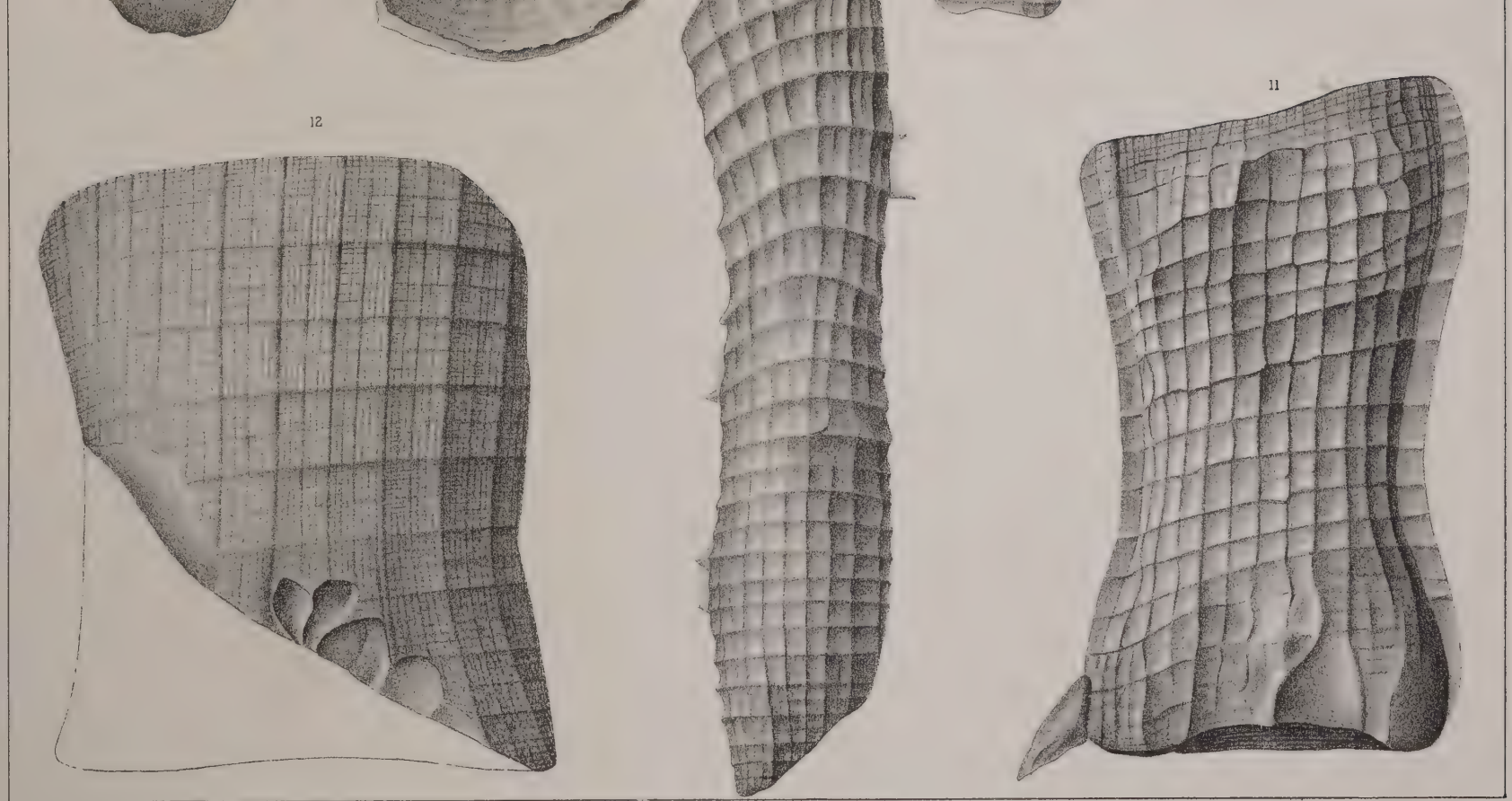


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PLATE XXV.

THYSANODICTYA, gen. nov.

Page 865.

(See Plates XIX, XXIII, XXIV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA SACCUS, sp. nov.

Page 870.

Figure 1. Lateral view of an entire individual showing its rapidly tapering form and contracted aperture.

Figure 2. Basal view of the same specimen which has been compressed and shows an irregular reticulum with a somewhat nodose margin.

Chemung group. *Whitesville, Allegany county, New York.*

CLATHROSPONGIA, Hall.

Page 861.

(See Plates XIV, XV, XVIII, XXI, XLIX, L.)

CLATHROSPONGIA (?) DESMIA, sp. nov.

Page 865.

Figure 3. A portion of the external surface of a species referred with doubt to this genus; showing the character of the primary quadrules.

Chemung group. *Alfred, New York.*

CLATHROSPONGIA VASCELLUM, Hall (sp.).

Page 863.

(See Plate XXI.)

Figure 4. One side of a large, somewhat waterworn fragment, with very large obscure primary quadrules and a distinct development of the subordinate spicular bands.

Chemung group. *Alfred, New York.*

CLATHROSPONGIA FENESTRATA, Hall (sp.).

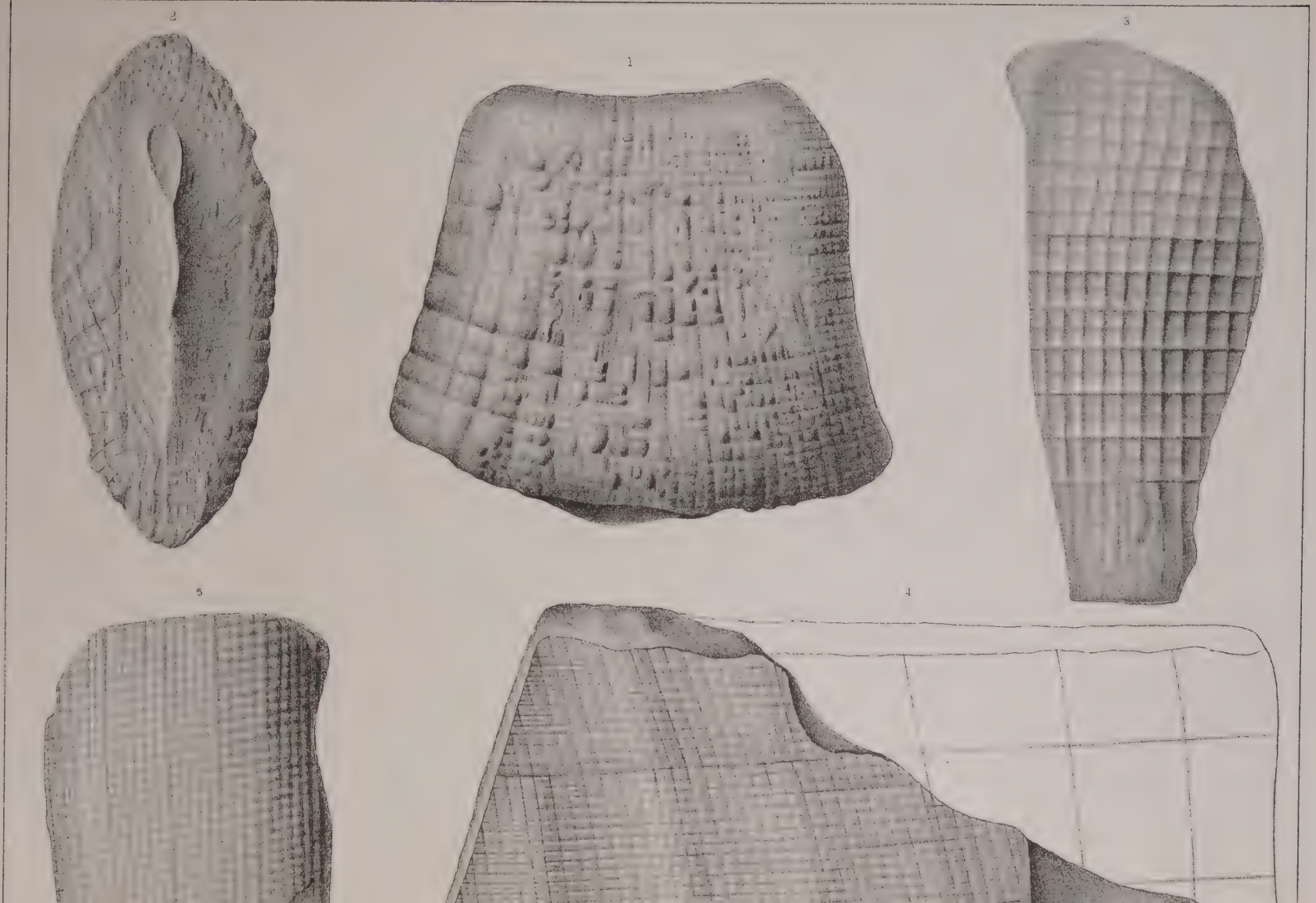
Page 862.

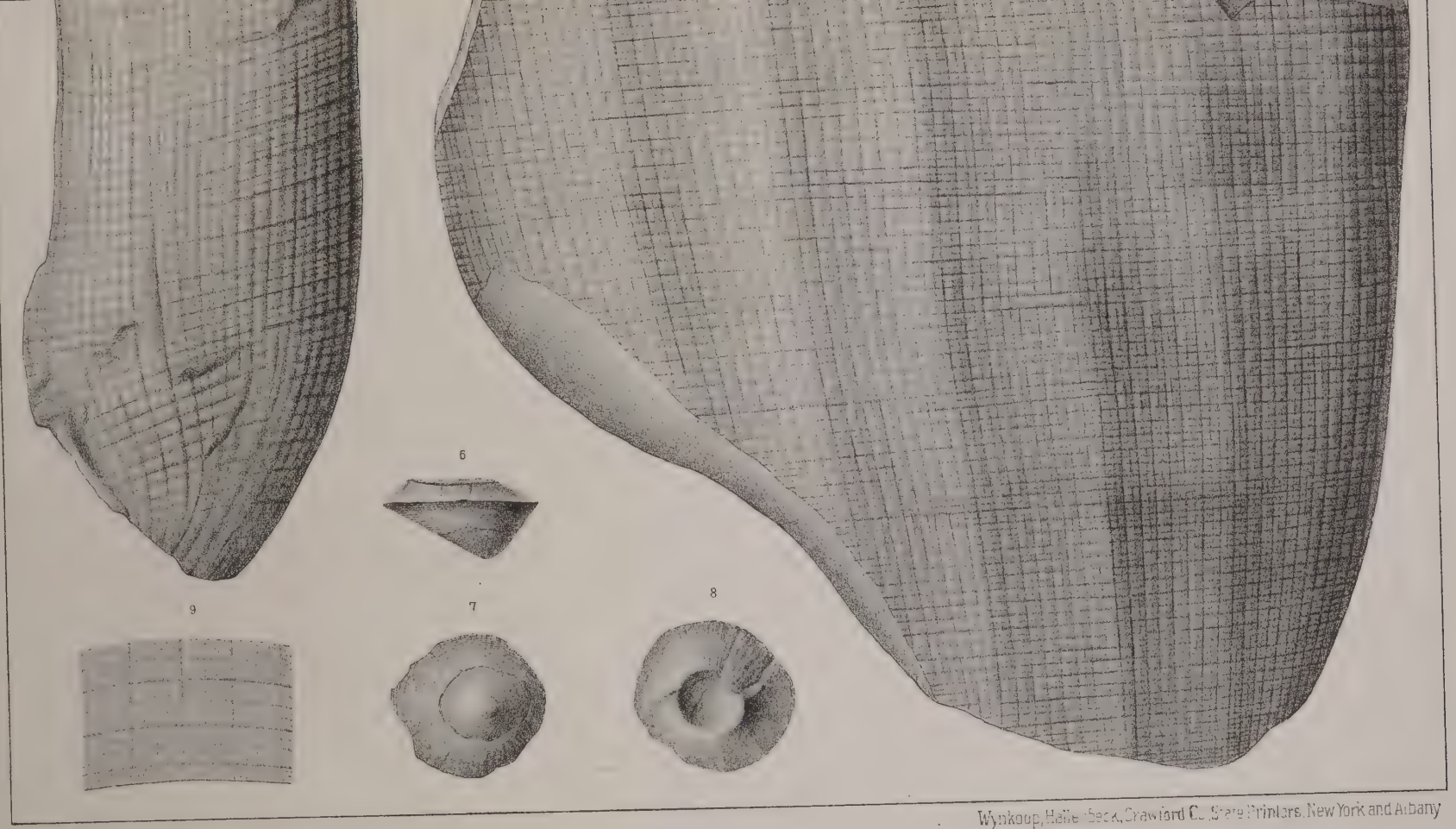
(See Plate XIV.)

Figure 5. An internal cast of a nearly entire cup.

Chemung group. *Chemung Narrows, New York.*

DICTYOSPONGIDÆ.





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AGLITHODICTYA, gen. nov.

Page 885.

AGLITHODICTYA NUMULINA, sp. nov.

Page 885.

Figures 6–8. Lateral, basal and apertural views of the same specimen; showing the size and peculiar form of the species, the character of the aperture with the surface canals on the oral slope, and the very fine reticulum.

Figure 9. An enlargement of the surface to show more distinctly the regular reticulations of the skeleton. x 4.

Chemung group. *Near Cohocton, Steuben county, New York.*

PLATE XXVI.

THYSANODICTYA, gen. nov.

Page 865.

(See Plates XIX, XXIII, XXIV, XXV, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA APLETA, sp. nov.

Page 875.

(See Plate XXVII.)

Figure 1. Portion of a very large specimen; drawn from a plaster cast of a natural mould.

Chemung group. *Alfred, New York.*

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DICTYOSPONG

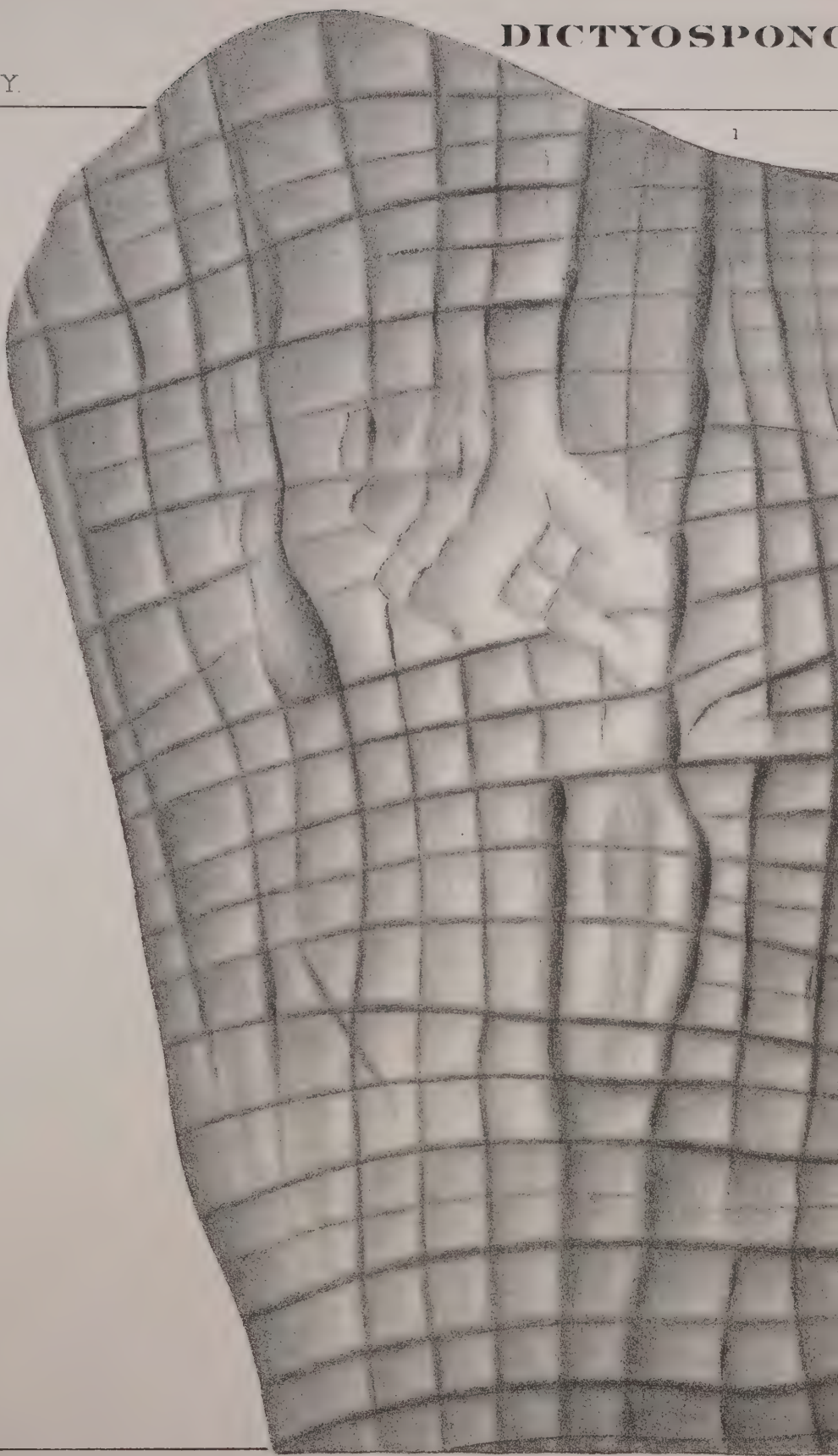

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Plate XXVI.

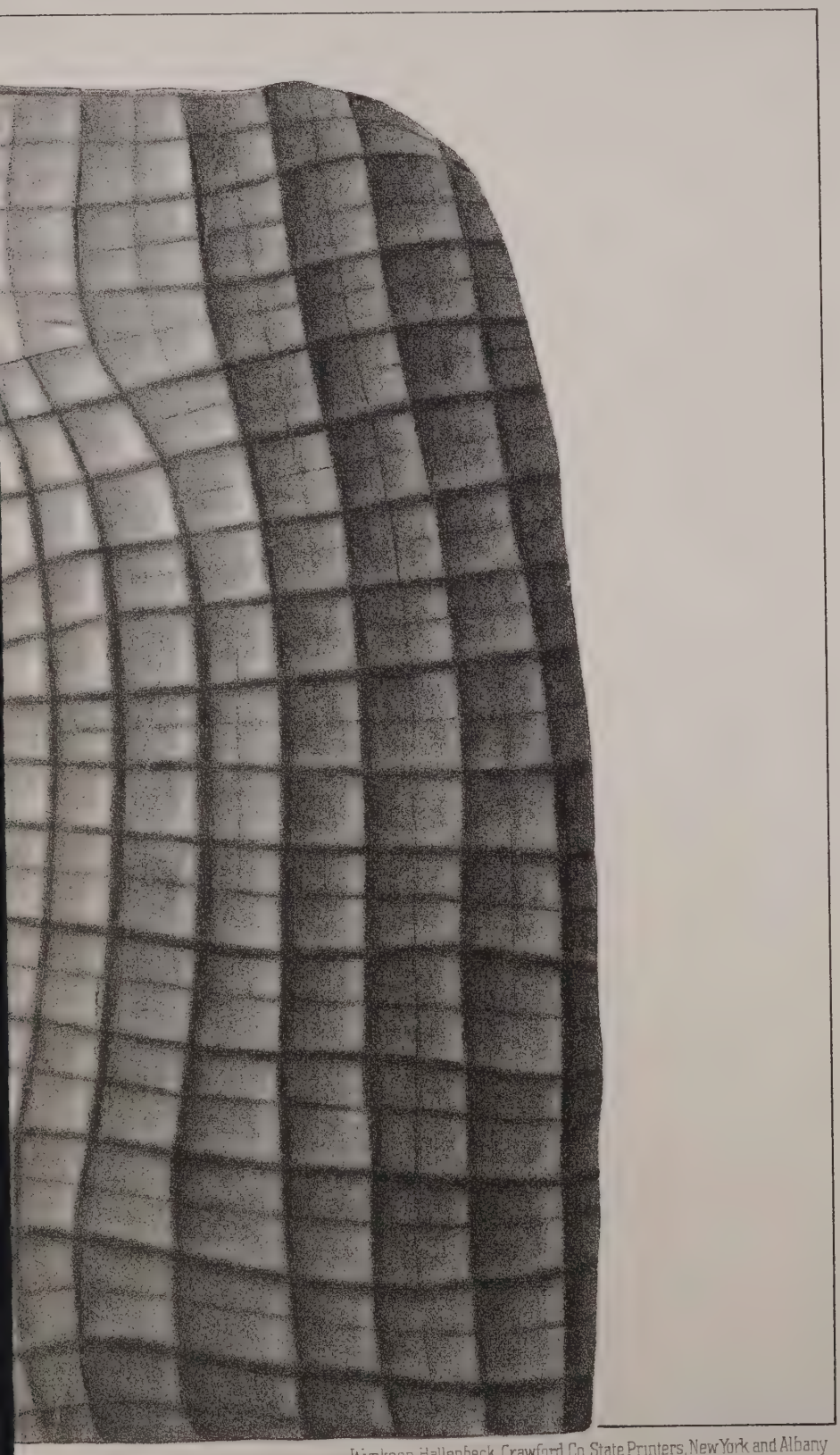

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PLATE XXVII.

HELICODICTYA, gen. nov.

Page 854.

(See Plate XXII.)

HELICODICTYA (?) SCIO, sp. nov.

Page 856.

Figure 1. A fragment of a frond which appears to have had a distinctly spiral mode of growth, with strong constrictions or impressions of ridges running parallel to one of the reticulating series.

Chemung group. *Scio, Allegany county, New York.*

HELICODICTYA (?) CONCORDIA, sp. nov.

Page 855.

Figure 2. A spirally growing sponge found associated with *Prismodictya prismatica* in the

Chemung group. *Concord station, Erie county, Pennsylvania.*

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XV, XVI, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

Page 813.

(See Plates XIV, XV, XVI, XXXVI.)

Figure 3. A small incomplete, somewhat compressed example with very fine reticulation.

Chemung group. *Wellsville, New York.*

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XIX, XX, XXI, XXXIII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA FILITEXTILIS, Hall (sp.).

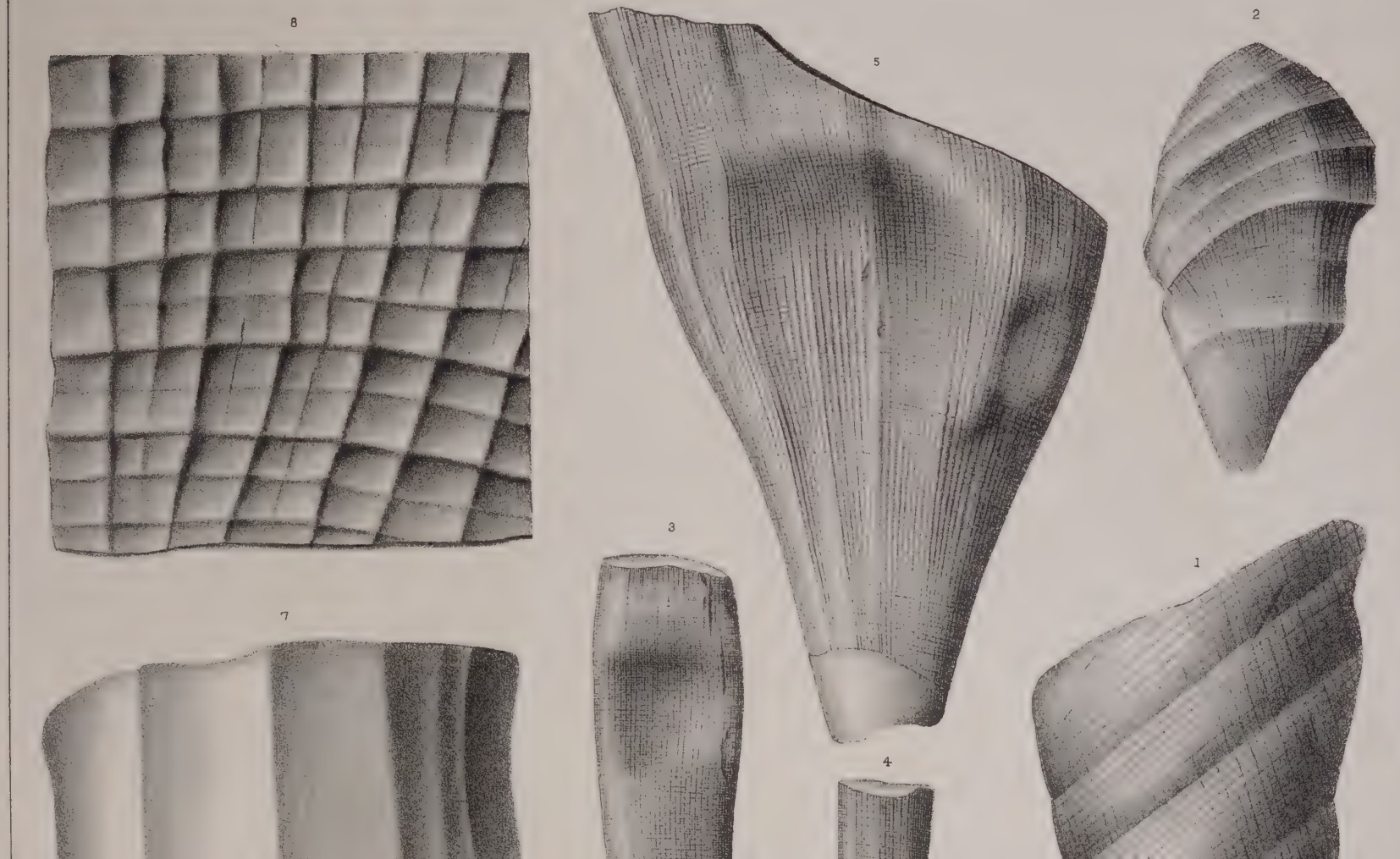
Page 826.

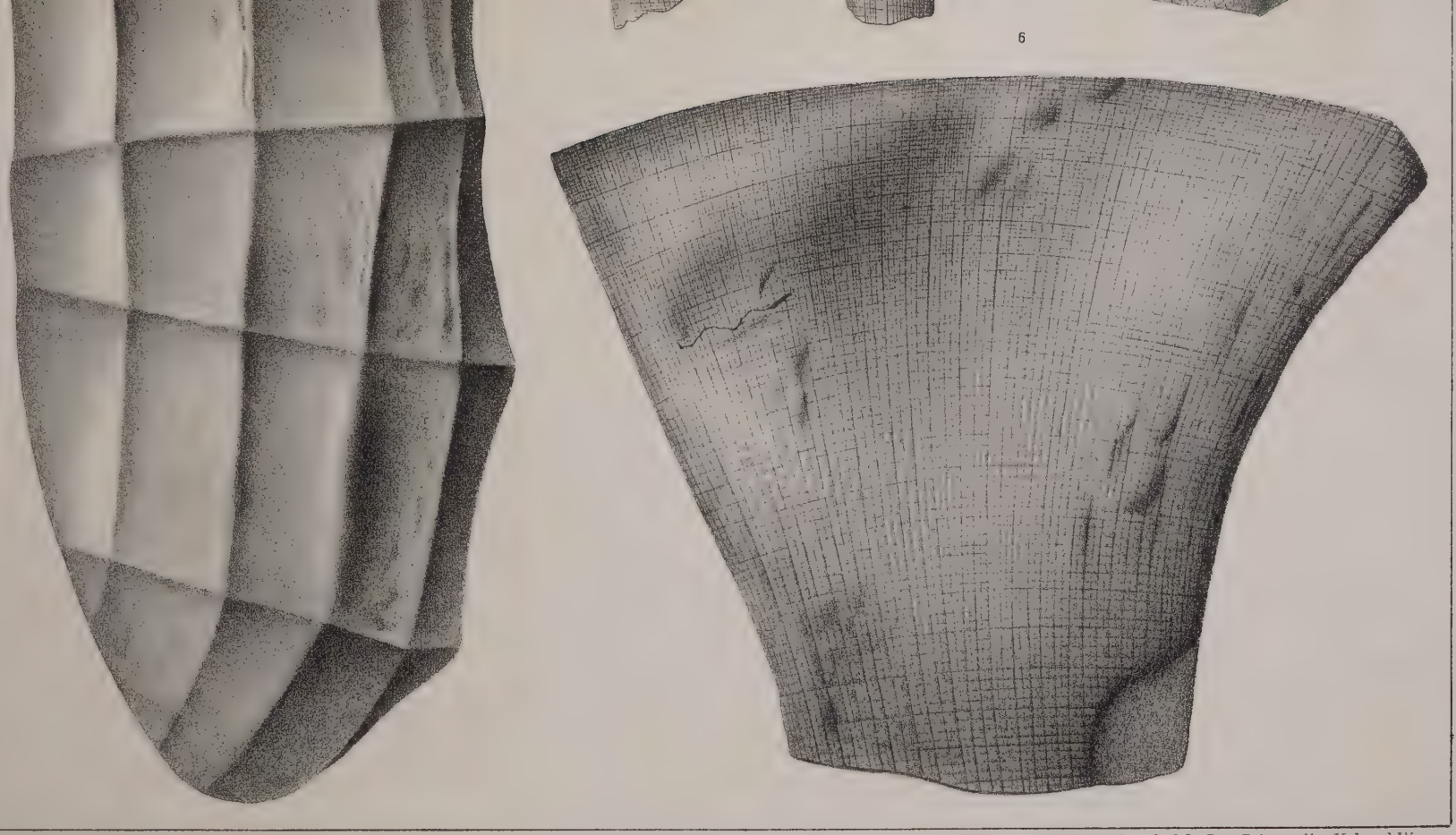
(See Plate XXI)

Figure 4. A fragment of an uncompressed individual showing the obscure prism-faces and fine reticulation.

Chemung group. *Wellsville, New York.*

DICTYOSPONGIDÆ.





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PRISMODICTYA CHOANEA, sp. nov.

Page 825.

(See Plates XIX and XXXV.)

Figure 5. The lower portion of a large cup showing obscurely prismatic faces.

Chemung group. *Ischua, Cattaraugus county, New York.*

DICTYOSPONGIA? (ECTENODICTYA?).

Figure 6. A flat and expanded portion of a frond, whose outline may represent the original form of the cup, although the edges appear to be somewhat ragged. The reticulation is very fine and the surface without evidence of prism-faces. The specific and generic relations of the specimen are uncertain.

Chemung group. *Wellsville, New York.*

THYSANODICTYA, gen. nov.

Page 865.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA HERMENIA, sp. nov.

Page 873.

(See Plates XXXIX and XL.)

Figure 7. The surface of an incomplete individual; showing the very strong primary bands and large quadrules. No evidence is retained of subordinate reticulation but the surface of the specimen has been involved in shale and the structure obscured. The drawing is made from a plaster-cast of a natural mould of the exterior.

Chemung group. *Alfred, New York.*

THYSANODICTYA APLETA, sp. nov.

Page 875.

(See Plate XXVI.)

Figure 8. A fragment of the surface, showing the coarse primary and secondary quadrules.

Chemung group. *Alfred, New York.*

PLATE XXVIII.

HYPHANTÆNIA, Vanuxem.

Page 877.

(See Plates XXIX and XLV.)

HYPHANTÆNIA CHEMUNGENSIS, Vanuxem.

Page 879.

(See Plates XXIX and XLV.)

Figure 1. An internal cast of the central or basal portion of a frond, showing the concentric and radiating ligulate bands and the open quadrate interspaces.

Figure 2. A view of the original specimen described and figured by Vanuxem. This shows the strongly elevated margins of the radial bands which are maintained at the intersections of these with the concentric bands.

Chemung group. *In the vicinity of Owego, Tioga county, New York.*

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1

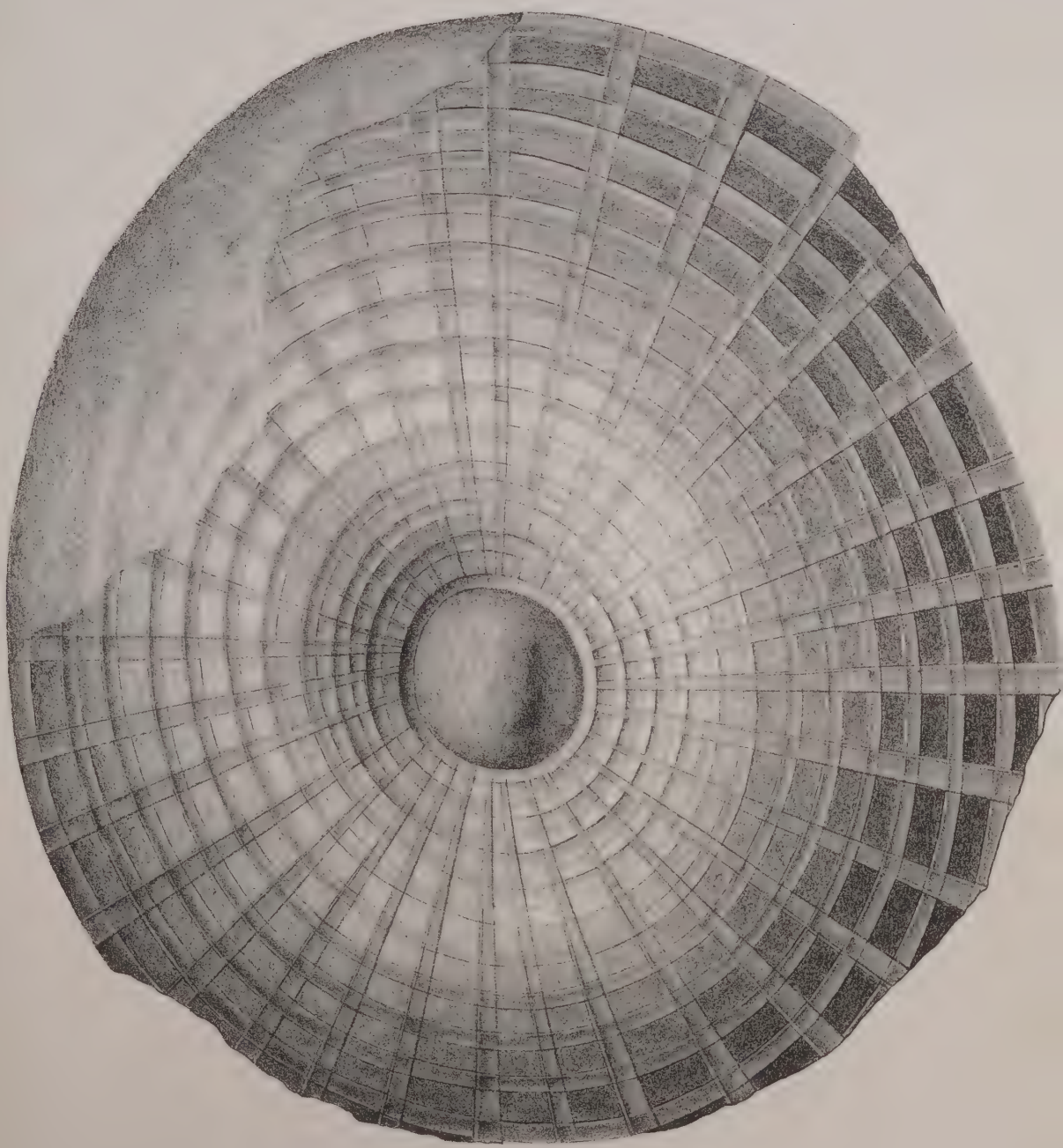

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PLATE XXIX.

HYPHANTÆNIA, Vanuxem.

Page 877.

(See Plates XXVIII and XLV.)

HYPHANTÆNIA CHEMUNGENSIS, Vanuxem.

Page 879.

(See Plates XXVIII and XLV.)

Figure 1. A fragment of a specimen whose entire diameter is probably represented. This appears to be a mould from an impression of the exterior, shows the expanding saucer-shaped form of the sponge, the rapid increase in the width of the radial bands, also their elevated margins and the open quadrangular interspaces made by the intersection of the two series of bands. The center of the specimen as well as that represented in figure 1 on the preceding plate lacks definition and lends probability to the inference that there was a tuft of basal spicules at this point.

Chemung group. *Near Owego, Tioga county, New York.*

DICTYOSPONG

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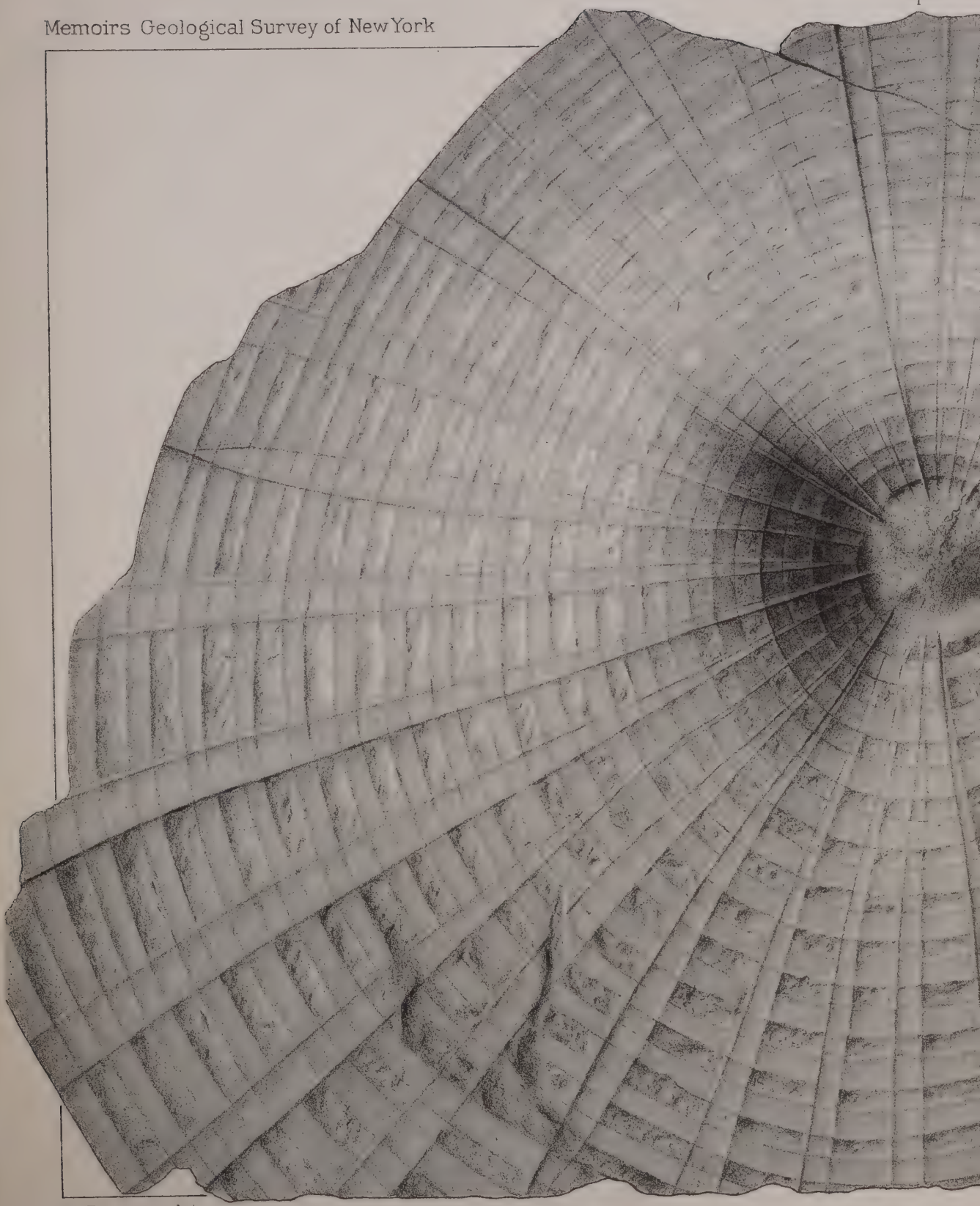

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Plate XXIX.

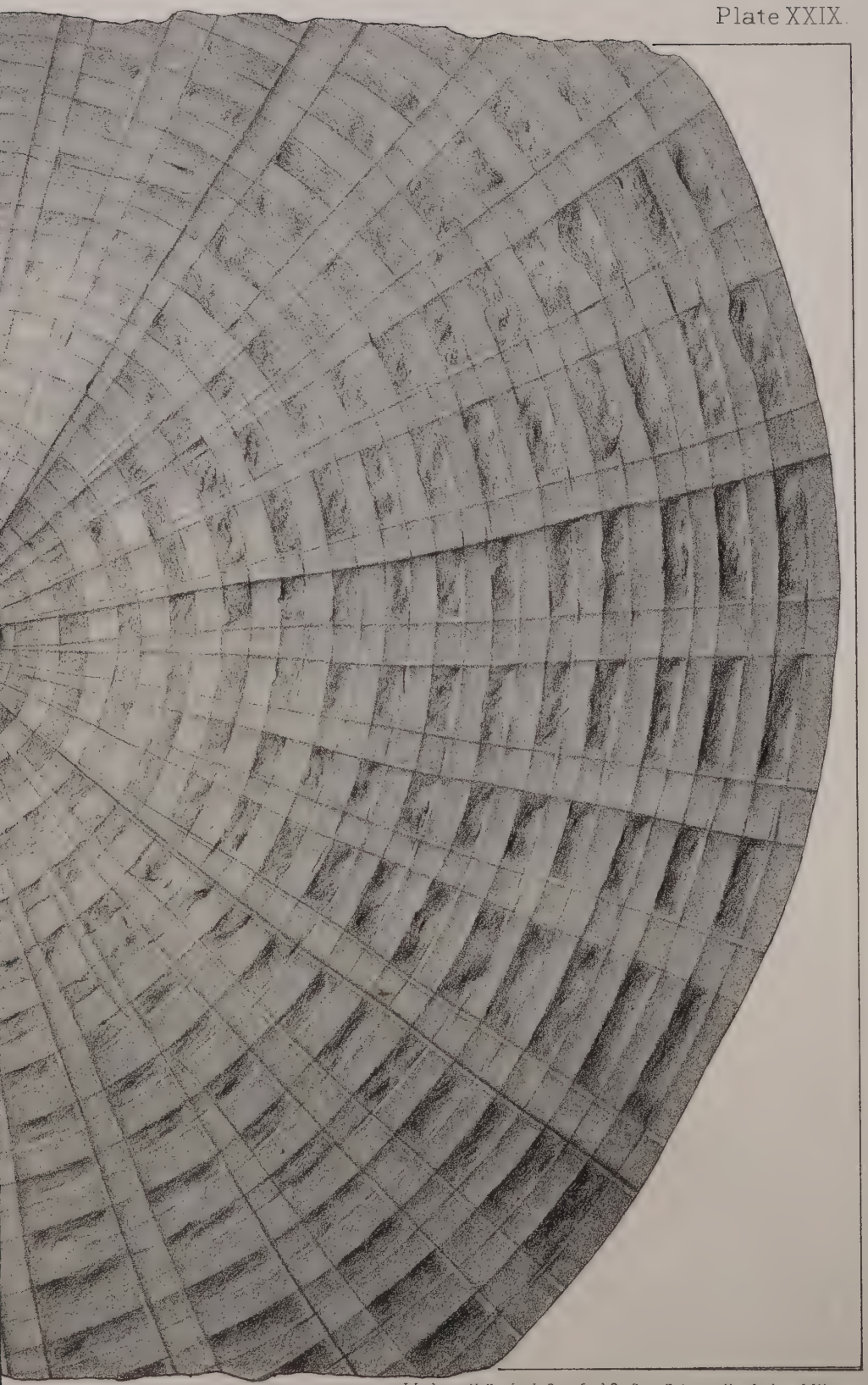

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PLATE XXX.

ACTINODICTYA, Hall.

Page 882.

(See Plate XXXI.)

ACTINODICTYA PLACENTA, Hall.

Page 883.

(See Plate XXXI.)

Figure 1. An irregularly oval frond showing great differences in the size of the spicular bands. In this specimen these bands show an unusually regular reticulation although the various series may intersect at different angles. The drawing has been made with accuracy but the apparent abundance of cruciform spicules is wholly due to elevation of reticulating spicular bands at and near their intersections; as these bands gradually die out, the more strongly projecting portions produce the effect observed.

Figure 2. Two essentially entire fronds, one partially overlapping the other and somewhat broken near one extremity. This specimen with that represented in figure 1 and that in figure 1 on Plate xxxi show the form of this fossil at the locality where it has been found in the greatest perfection and without evidence of much distortion. Such specimens indicate that the bodies were broad, convex expansions, evidently not of highly irregular growth but with a definite marginal outline and uboval form.

Chemung gr up. *One-half mile from Brown hill, near Cohocton, New York.*

Figure 3. A fragment of a specimen the surface of which bears irregularly scattered spots representing subcircular perforations of the spicular net-work. These may be to some extent due to accident.

Chemung group. *Near Howard, New York.*

DICTYOSPONGIDÆ.

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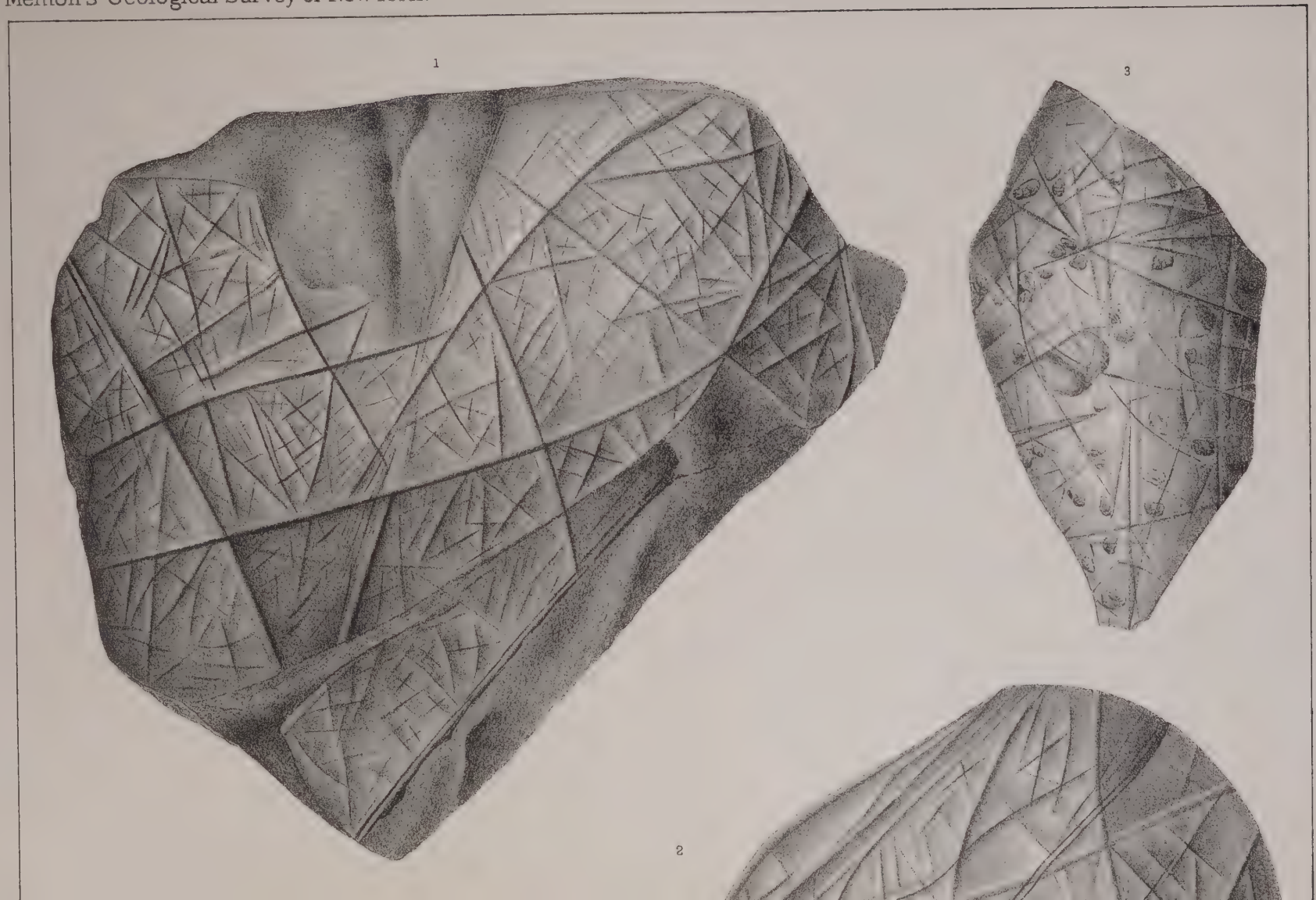
Plate XXX.



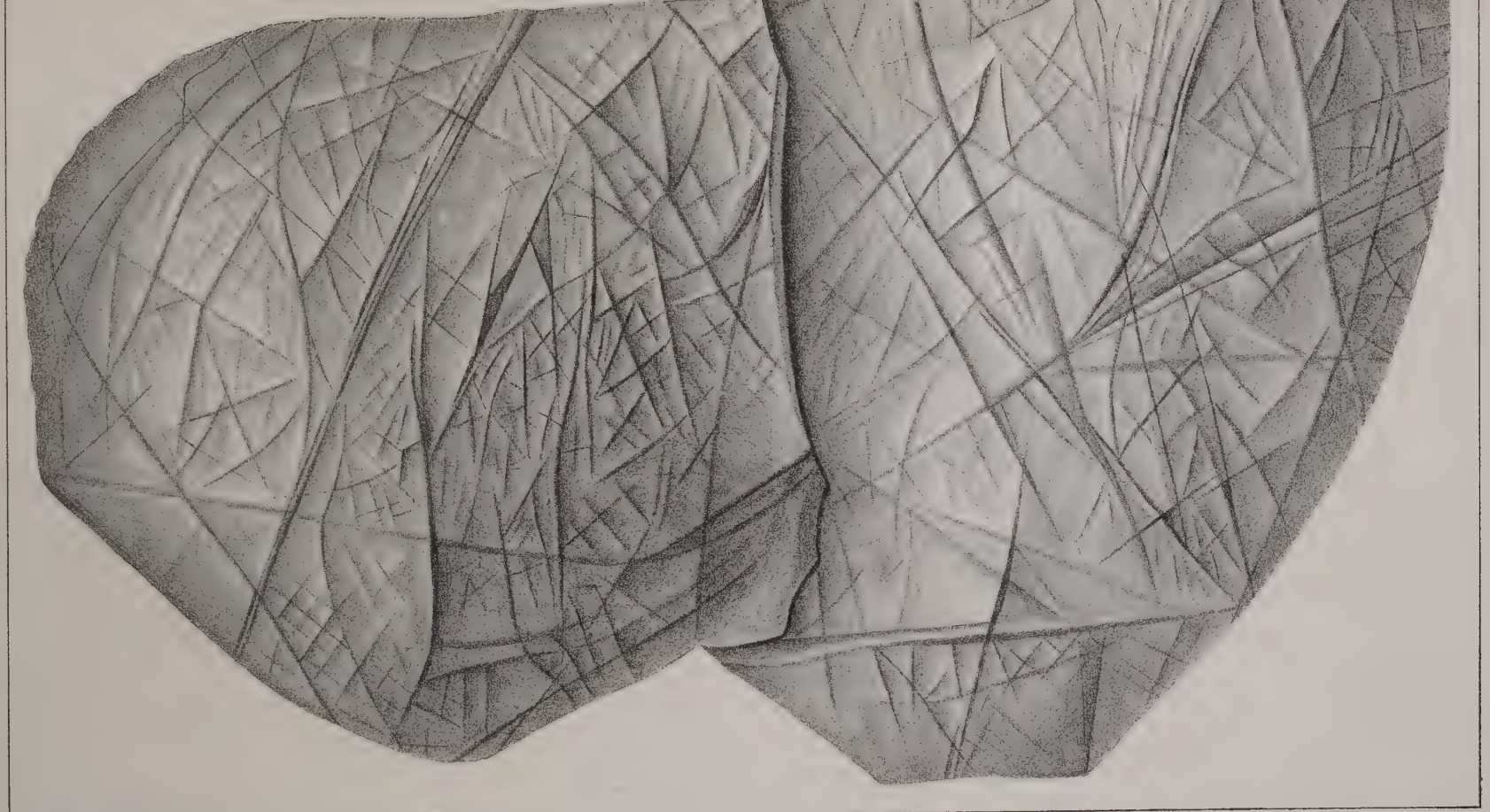


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PLATE XXXI.

ACTINODICTYA, Hall.

Page 882.

(See Plate XXX.)

ACTINODICTYA PLACENTA, Hall.

Page 883.

(See Plate XXX.)

Figure 1. A very nearly complete frond showing the regularity of much of the finer reticulation.

Chemung group. *One-half mile from Brown hill school house near Cohocton, New York.*

Figure 2. A small frond, with well defined margins indicating completed peripheral growth.

Chemung group. *Brown hill colony, near Cohocton, New York.*

CRYPTODICTYA, Hall.

Page 884.

(See Plate XXXII.)

CRYPTODICTYA ALLENI, Hall.

Page 884.

(See Plate XXXII.)

Figure 3. A portion of a nodose margin of a specimen which shows that these nodes bore tufts of spicules. Such tufts are seen only when the nodes lie at the margins of the surface expansion and the tufts extend along the plane of lamination of the matrix.

Figure 4. An irregular frond showing on one side the abrupt depression of the nodose surface to the broad, anodose marginal expansion.

Figure 5. A large specimen in which the nodes are arranged in groups. This frond has been folded along the right margin, the opposite side being of the same extent as that here represented, and having the nodes similarly arranged in clusters. This folding of the frond is, however, probably wholly due to compression.

Chemung group. *Lyndon, Cattaraugus county, New York.*

DICTYOSPONGIDÆ.

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Plate XXXI.

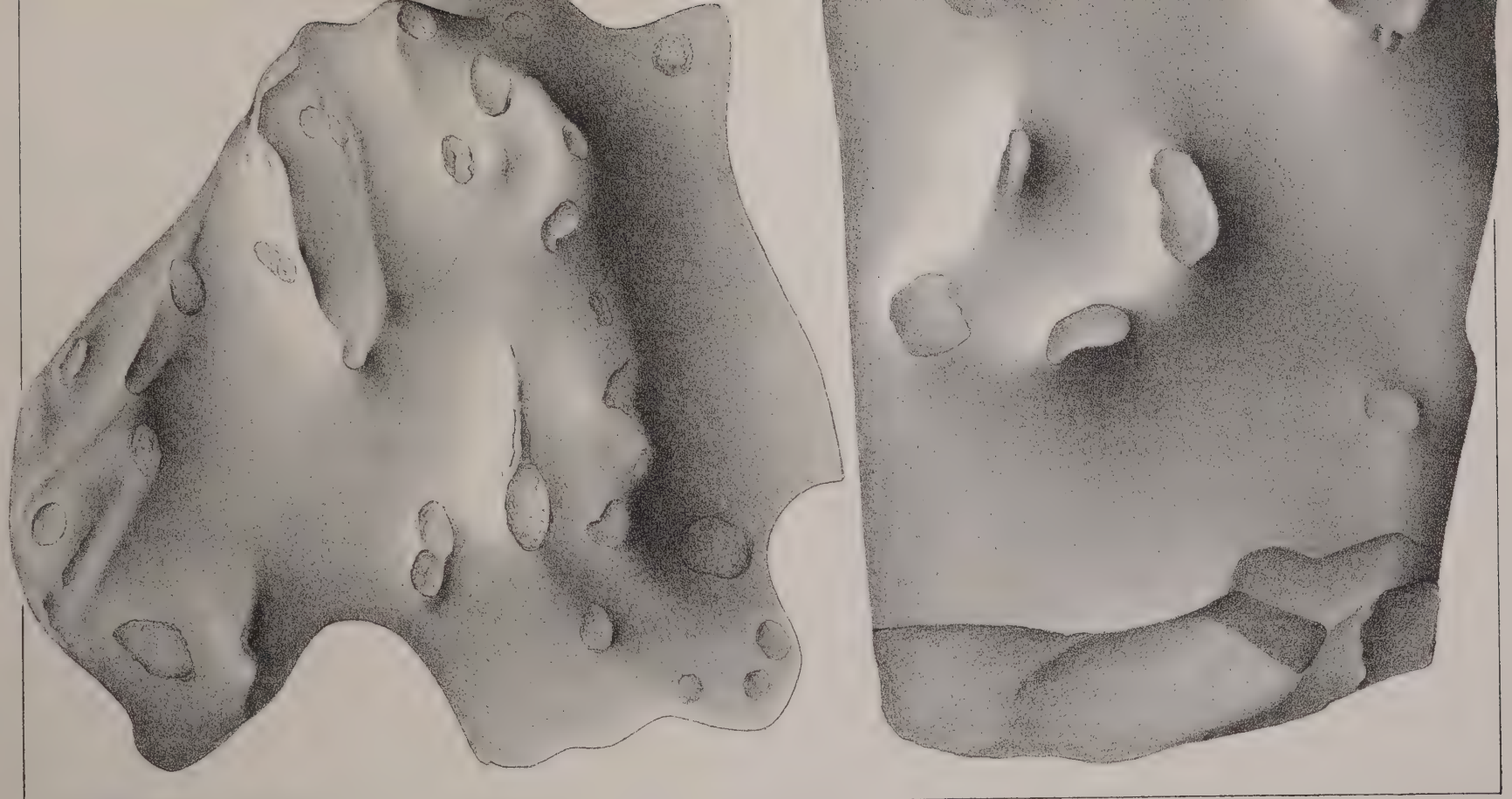

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PLATE XXXII.

CRYPTODICTYA, Hall.

Page 884.

(See Plate XXXI.)

CRYPTODICTYA ALLENI, Hall.

Page 884.

(See Plate XXXI.)

Figure 1. The nodose portion of a large specimen. This appears to have been a lateral or extremital portion of a frond where the surface is marked by oblique angular curved ridges terminating in swollen nodose elevations. Several of these ridges show coarse lines or grooves radiating from the summit, and over the broad general slope of the surface as well as between the ridges are seen traces of spicular lines.

Figure 2. A small fragment representing a partially enfolded, narrow portion of a frond, bearing a divided node on the surface.

Figure 3. A specimen of subclavate outline, exhibiting the flattened nodose surface, the sides falling away vertically in all directions, except below. These specimens all indicate that the original form of the frond was a suboval expansion having a slight elevation, a nodose upper or expanded surface and probably was attached by the free margins or by the narrowed extremity.

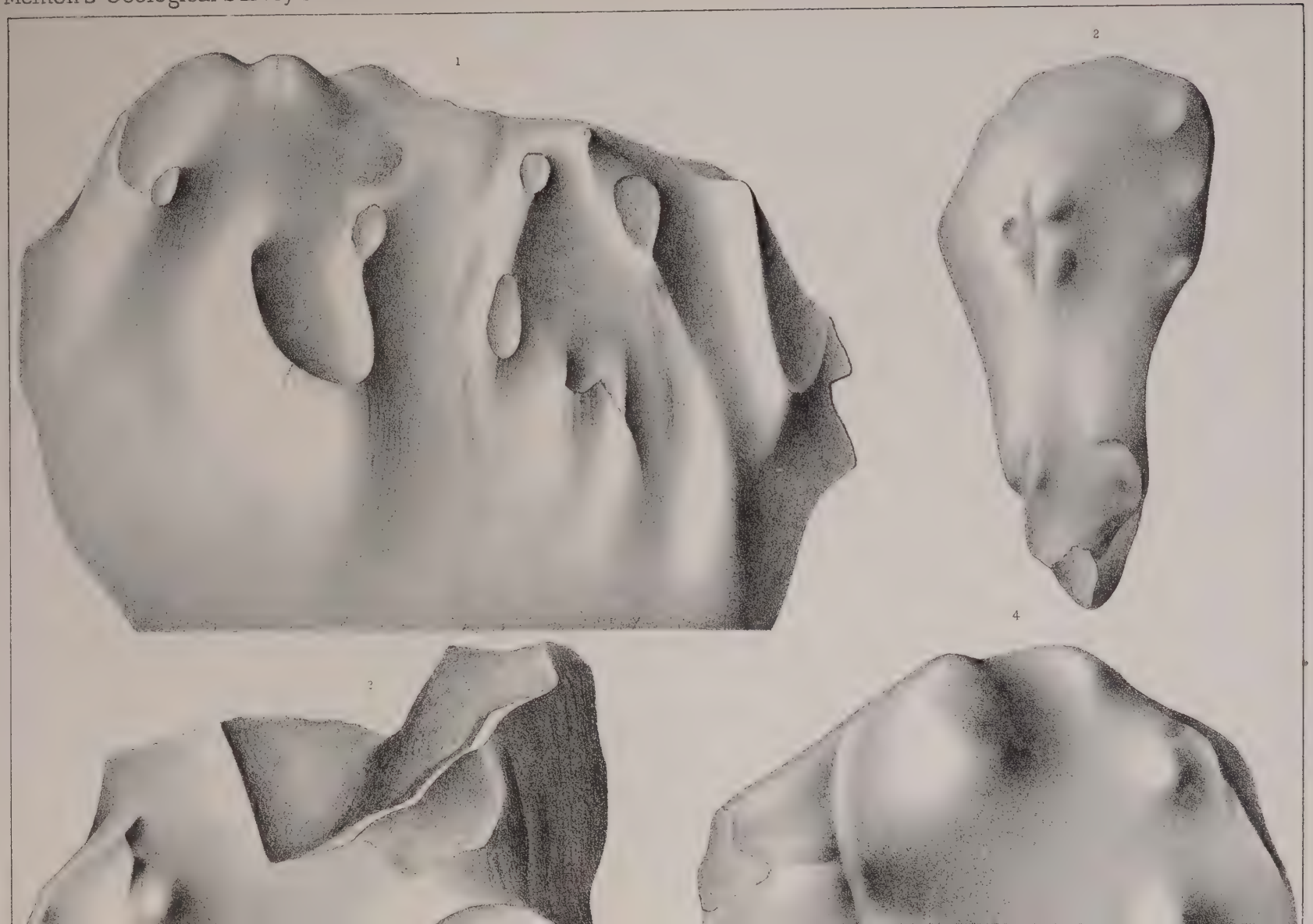
Figure 4. A somewhat similar portion of a frond showing the irregularly nodose surface. The margins of the expansion are bent vertically downward on all sides except the posterior and the specimen appears to be the elevated and flattened surface of the frond.

Chemung group. *Near Lyndon, Cattaraugus county, New York*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate XXXII.



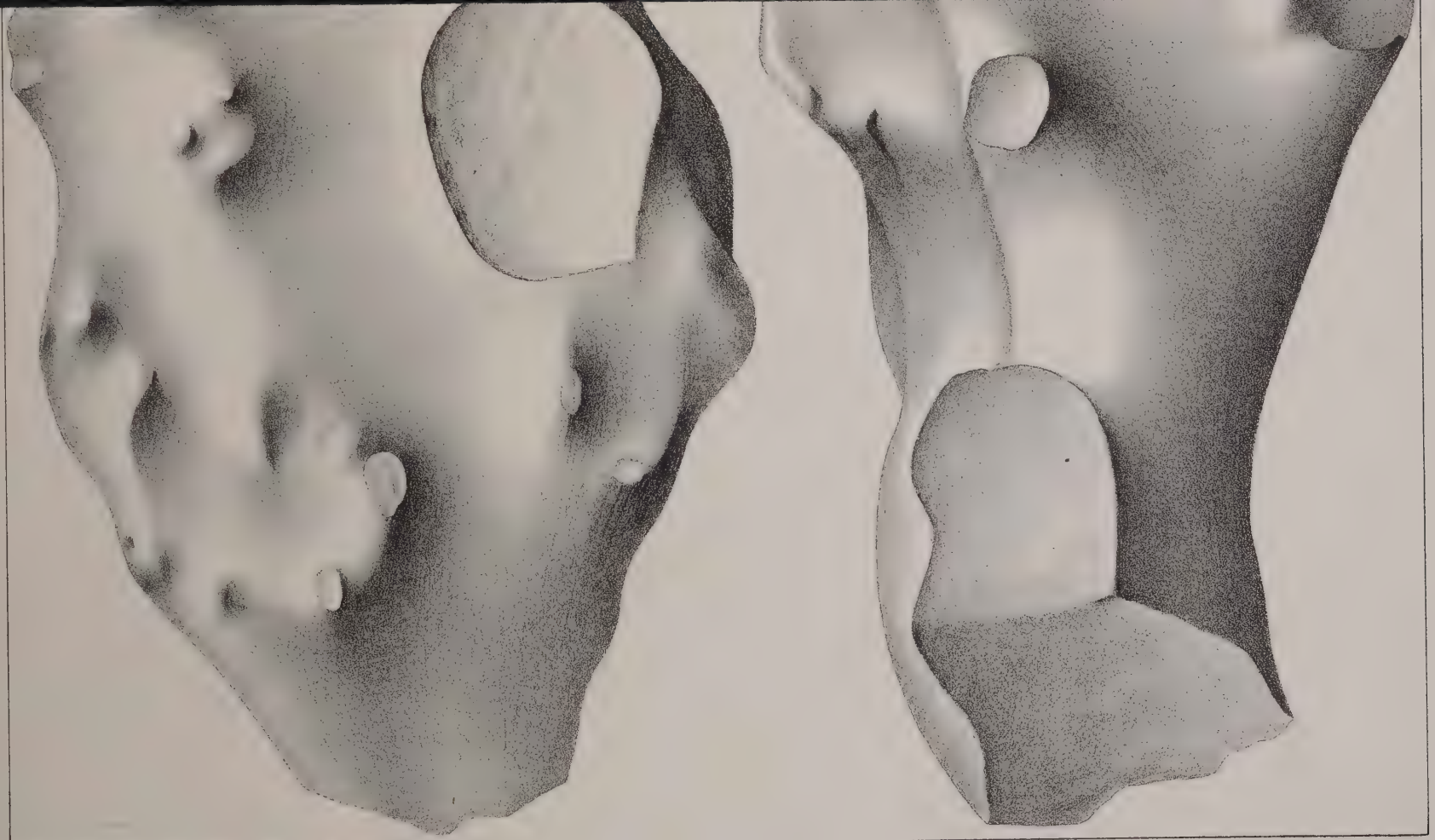


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PLATE XXXIII.

DICTYSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XV, XVI, XXVII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA HAPLEA, sp nov.

Page 808.

Figure 1. The larger and more complete of the specimens observed; showing the smooth non-prismatic surface and a contraction of diameter near the aperture.

Portage group. *Naples, New York.*

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIV, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA PALÆA, sp. nov.

Page 809.

Figure 2. The original specimen; a nearly entire individual showing faint prism-faces and indications of low horizontal depressions.

Portage group. *Naples, New York.*

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXVI, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS GRACILE, sp. nov.

Page 810.

Figures 3, 4. Two specimens, entire in the extent of the cup from base to aperture, but foreshortened by vertical compression. They show three horizontal rows of nodes with traces of incipient nodes near the aperture.

Portage group. *Varysburg, New York.*

HYDNOCERAS LEGATUM, sp. nov.

Page 809.

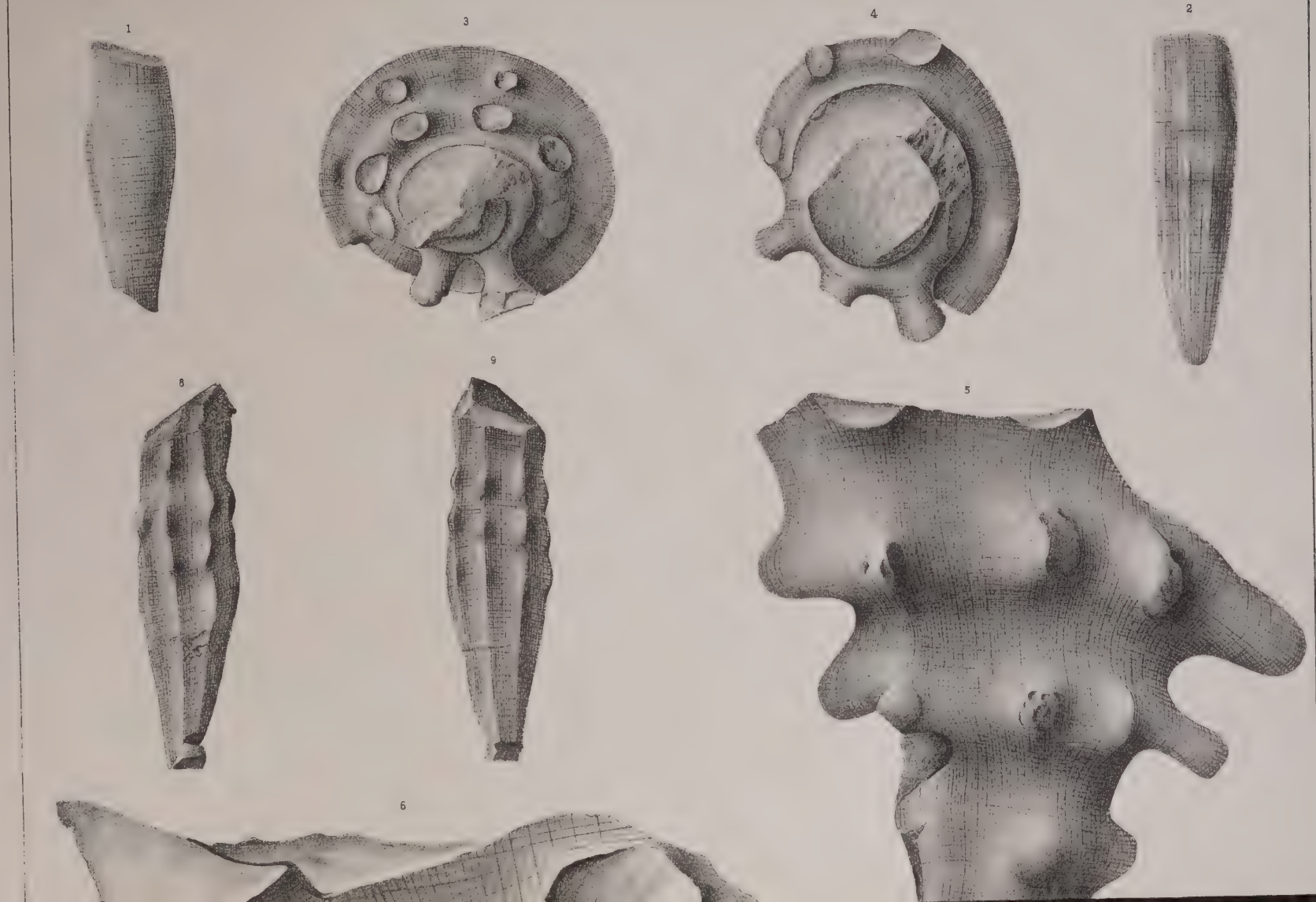
Figure 5. A specimen of medium size with apex preserved and bearing three horizontal rows of nodes.

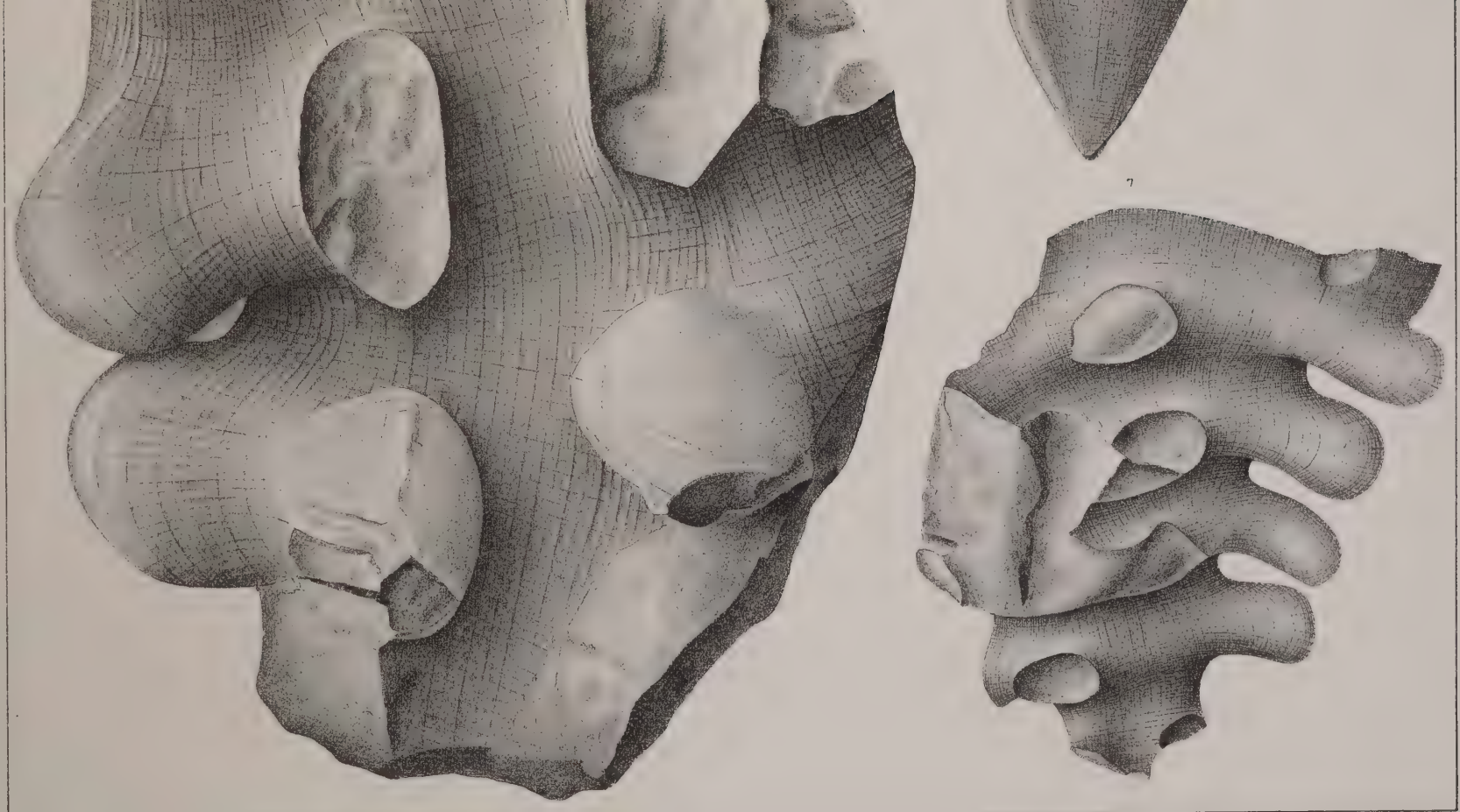
Portage group. *Naples, New York.*

Figure 6. Fragment of a very large example with broad nodes, similar to those in *H. Avoca.*

Portage group. *Varysburg, New York.*

DICTYOSPONGIDÆ.





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HYDNOCERAS EUTHELES, sp. nov. (?)

Page 810.

(See Plate VIII.)

Figure 7. A fragment with elongated, subpendulous nodes, similar to those shown in the figures of this species on Plate viii (figs 5 and 6).
Portage group. *Varysbury, New York.*

HYDNOCERAS ANTHRACIS, sp. nov.

Page 849.

(See Plates II and VI.)

Figures 8, 9. Opposite sides of the most complete example observed; showing the sharply prismatic anodate lower half of the sponge and the three horizontal rows of low nodes of the upper half lying on, and ridged by the prism-angles.
Chemung group. *Scio, New York.*

PLATE XXXIV.

CLEPSYDROSPONGIA, gen. nov.

Page 811.

CLEPSYDROSPONGIA MATUTINA, sp. nov.

Page 811.

Figures 1, 2. Opposite sides of the original specimen; showing the subequal expansion of the extremities and the contracted median nodose area. Figure 1 is drawn from the specimen as it lies in its matrix and shows the node-tufts even at spots where no nodes are clearly developed on the surface.

Portage group. *Naples, New York.*

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA PTIONIA, sp. nov.

Page 828.

Figure 3. The original specimen showing its great expansion near the middle and its concave prism-faces.

Chemung group. *Scio, New York.*

PRISMODICTYA AULOPHIA, sp. nov.

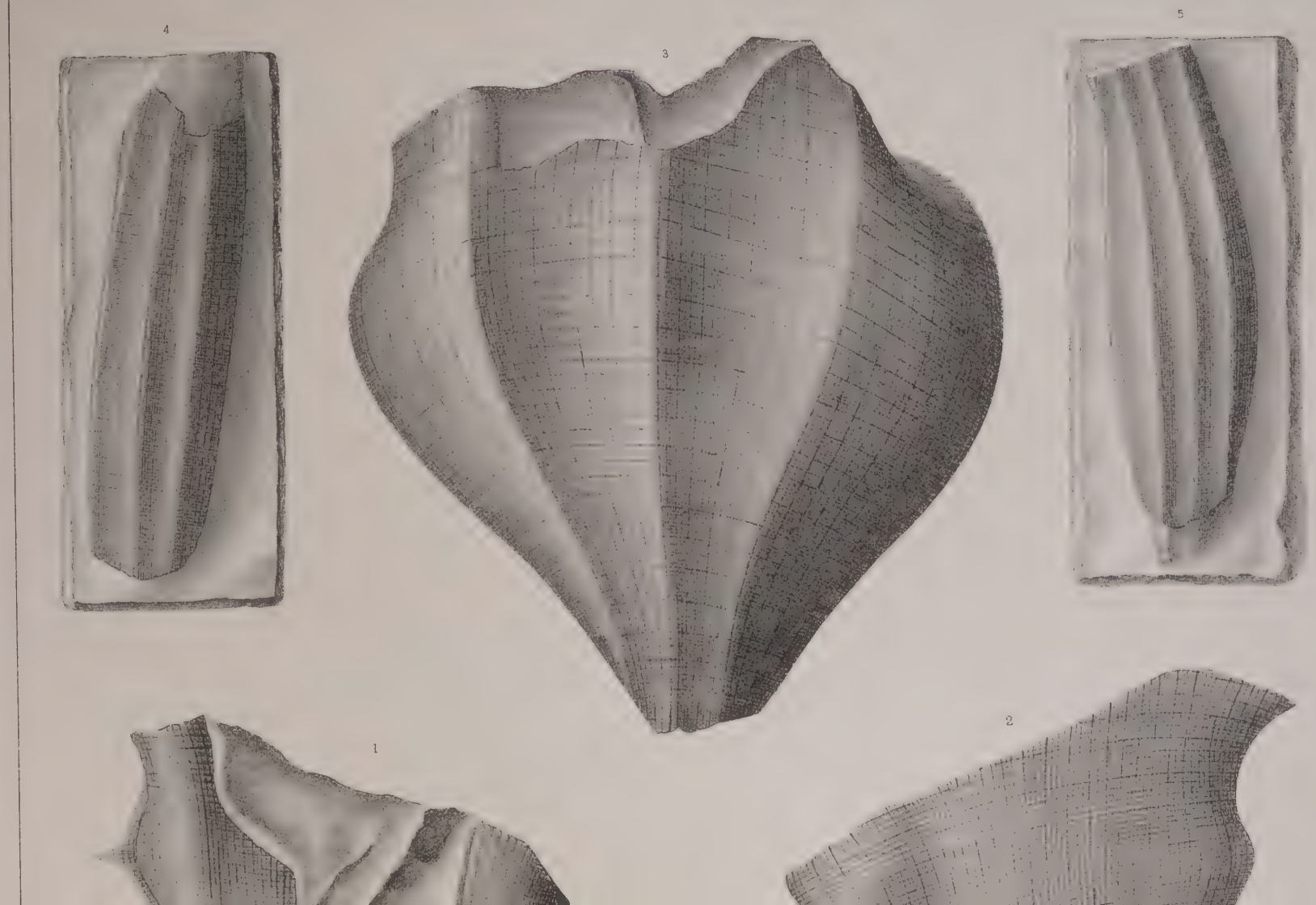
Page 828.

(See Plates XX and XLI.)

Figures 4, 5. Two specimens; showing the elongate form and concave faces. These specimens are from a fragment of rock which contains traces of numerous other individuals of this species.

Chemung group. *Scio, New York.*

DICTYOSPONGIDÆ.



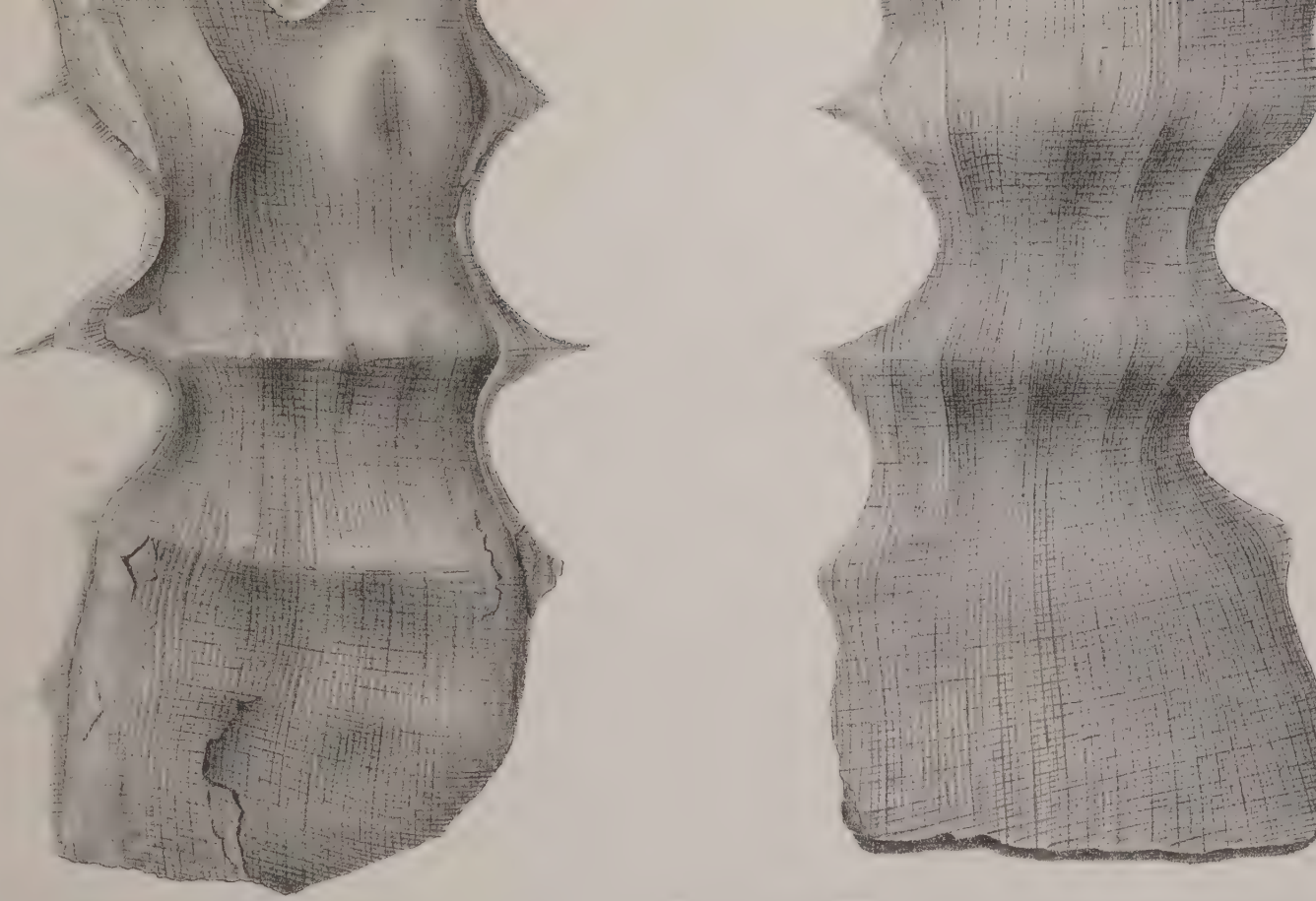


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PLATE XXXV.

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXVI, XLI, XLII, LV.)

PRISMODICTYA CITHARA, sp. nov.

Page 830.

(See Plate XXXVI.)

Figures 1, 2. Opposite sides of the same specimen, complete at the aperture but imperfect toward the base; showing the abrupt expansion of the cup in the upper part of the sponge, with low nodes at the elevated portions of the prism-angles.

Figure 3. Another specimen showing similar characters.

Chemung group. *Scio, New York.*

PRISMODICTYA NARTHECIA, sp. nov.

Page 830.

Figures 4, 5. Two views of the typical specimen, an elongate and slender sponge with but slight expansion above the middle.

Chemung group. *Scio, New York.*

PRISMODICTYA CHOANEA, sp. nov.

Page 825.

(See Plates XIX and XXVII.)

Figure 6. Fragment of a large individual with low prism-faces (too strongly rendered in the drawing).

Chemung group. *Olean, New York.*

PRISMODICTYA TELUM, Hall (sp.).

Page 820.

(See Plates XVII and XLII.)

Figures 7, 8. Two nearly entire specimens bearing low prism-faces and showing the characteristic expansion of the frond near the base.

Chemung group. *Friendship, New York.*

PRISMODICTYA PARALLELA, Hall (sp.).

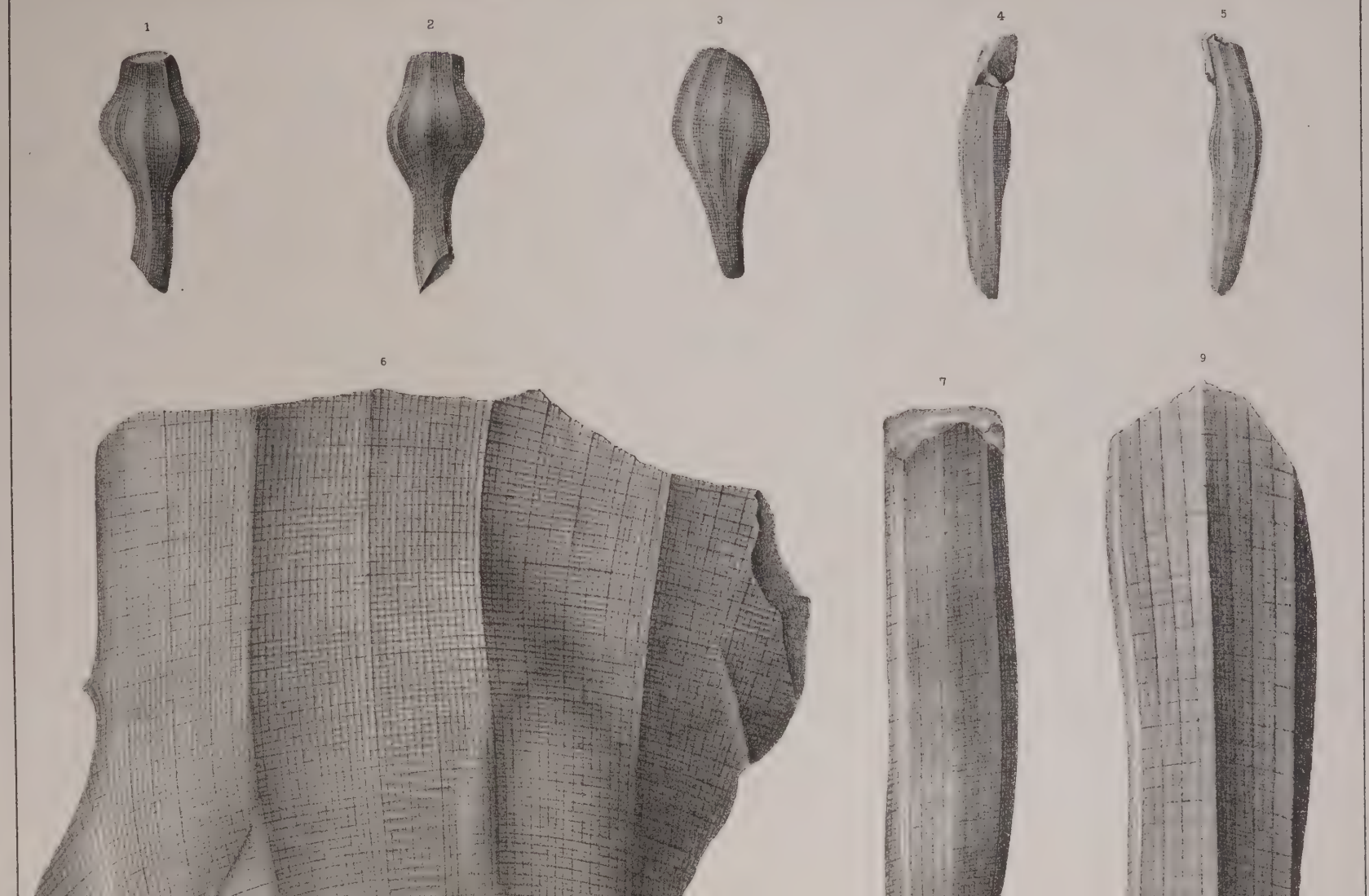
Page 822.

(See Plates XIX and XXI.)

Figure 9. A part of a very long specimen showing little increase in diameter throughout its length.

Chemung group. *Hinsdale, New York.*

DICTYOSPONGIDÆ.



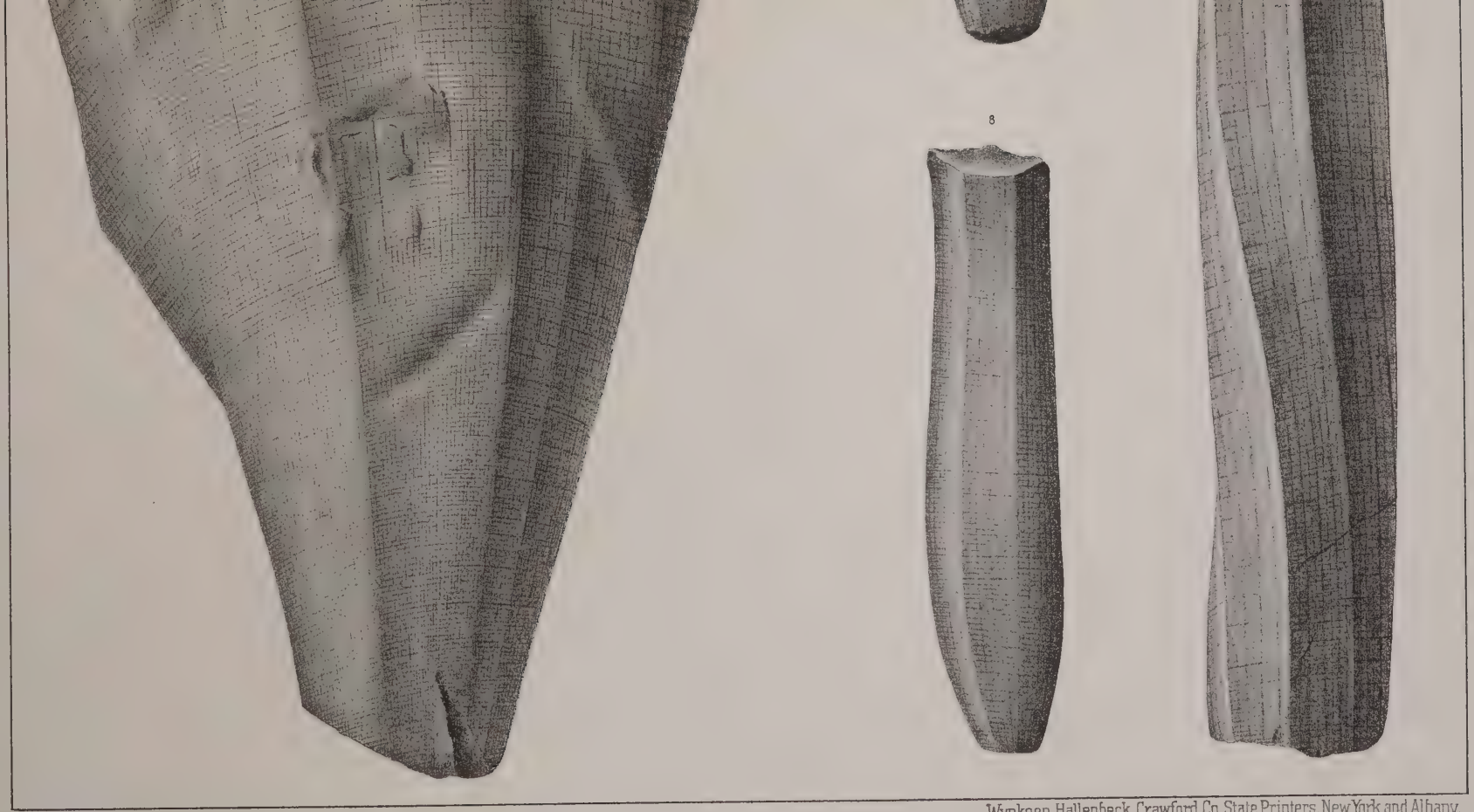


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PLATE XXXVI.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVII, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS VARIABILE, sp. nov.

Page 848.

(See Plate XXXVII.)

Figure 1. The apical portion of a specimen with coarse, strong, subequal meshes. There is no indication of nodes upon the surface of the cast, except near the broken end, but the matrix shows the presence of nodal tufts in this region.
Lower Chemung. *Deyo basin, Naples, New York.*

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XLI, XLII, LV.)

PRISMODICTYA AMICITLÆ, sp. nov.

Page 827.

Figures 2, 3. Two specimens which show the elongate and slender form of the species, with the abrupt and gradually declining expansion of the sponge above the base.

Figure 4. This specimen, found in association with numerous individuals of this species, shows a spiral twisting of the frond, resulting from abnormal growth.
Chemung group. *Friendship, New York.*

PRISMODICTYA CITHARA, sp. nov.

Page 830.

(See Plate XXXV.)

Figure 5. A large and somewhat distorted specimen of this species in which the nodes upon the expanded portion are rendered conspicuous by compression of the prism-faces.
Chemung group. *Scio, New York.*

DICTYOSPONGIDÆ.

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PRISMODICTYA sp. ?

Figure 6. A compressed, expanded and somewhat twisted frond whose specific relations have not been determined. It bears some relation to *P. ptionia* but differs therefrom in its less abrupt expansion and broader, shorter basal region.
Chemung group. *Scio, New York.*

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SCEPTRUM, Hall (sp.).

Page 813.

(See Plates XIV, XV, XVI, XXVII.)

Figure 7. The basal end of a specimen, showing a portion of the long anchoring tuft.
Chemung group. *Ischua, New York.*

HALLODICTYA, gen. nov.

Page 880.

(See Plate XLI.)

HALLODICTYA SCIENSIS, sp. nov.

Page 880.

Figure 8. The original specimen, showing the expanded, irregular and nodose character of the sponge. The reticulation is, in itself, regularly constructed but conforms to the highly uneven surface. This specimen is a mould of the exterior surface and the depressions represented on the drawing indicate nodes of the outer surface.
Chemung group. *Scio, New York.*

PLATE XXXVII.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVIII, XXXIX, XLVI.)

HYDNOCERAS RHOPALUM, sp. nov.

Page 847.

Figures 1, 2. Opposite sides of a very slender, somewhat malformed specimen with faint indications of nodes over the lower half of the surface. The mode of growth here exhibited and the general aspect of the sponge is quite distinct from that of *H. tuberosum*, in association with which this specimen was found.

Chemung group. *Brown hill colony, near Cohocton, New York.*

HYDNOCERAS PHYMATODES, sp. nov.

Page 844.

(See Plate VI.)

Figure 3. A small nearly entire specimen with five well defined horizontal rows of rather low nodes and two faintly developed additional rows, one at the base and one at the aperture.

Lower Chemung. *Italy, Yates county, New York.*

HYDNOCERAS VARIABILE, sp. nov.

Page 848.

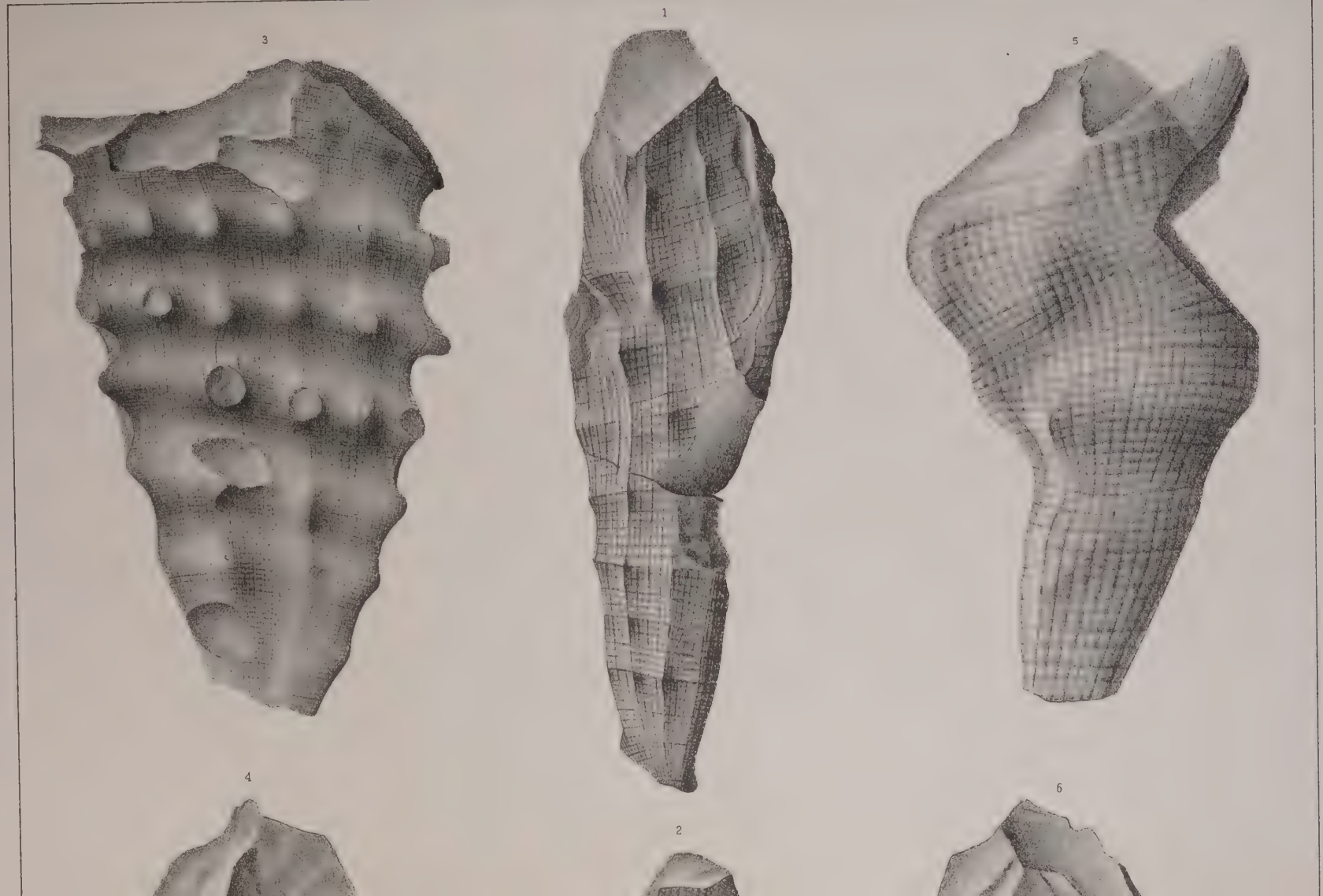
(See Plate XXXVI.)

Figures 4, 6. Opposite sides of a specimen preserving the apertural portion of the sponge and showing the indistinct nodes and irregular form which characterize the species.

Figure 5. Another specimen showing similar characters and the coarse reticulation of the cast.

Lower Chemung. *Deyo basin, Naples, New York.*

DICTYOSPONGIDÆ.



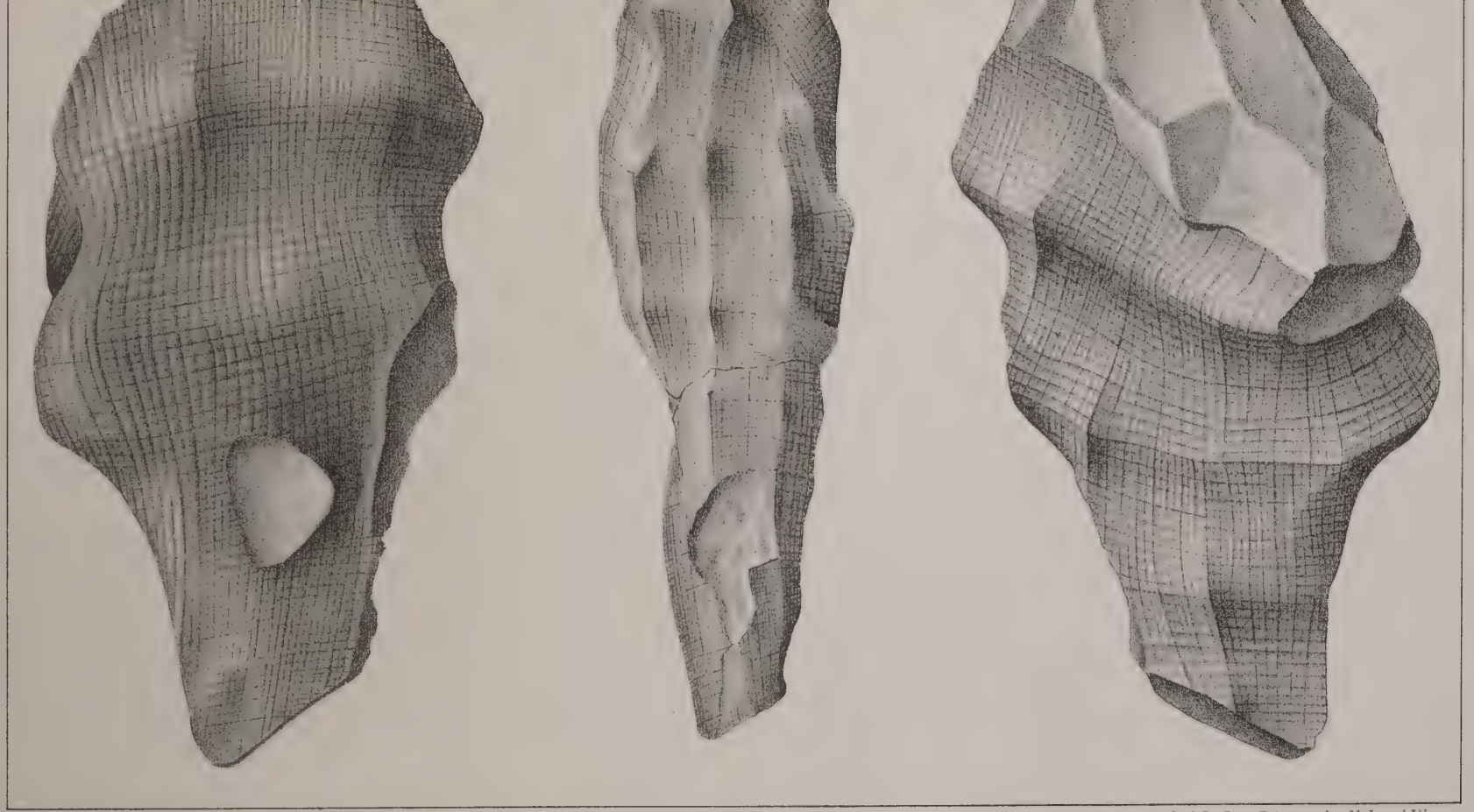


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PLATE XXXVIII.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXIX, XLVI.)

HYDNOCERAS TUBEROSUM, Conrad.

Page 837.

(See Plates II, III, IV, V, VI, VII, VIII.)

Figures 1, 2. Opposite sides of a short compressed specimen of somewhat irregular growth and unusual in the number of nodes (eleven) in the second and third horizontal rows.

Lower Chemung. *Brown hill colony, near Cohocton, New York.*

THYSANODICTYA, gen. nov.

Page 865.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXVII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA QUASILLUM, sp. nov.

Page 871.

Figures 3, 4. Opposite sides of a specimen figured to illustrate the extreme difference in retention of the reticulum possible in the same specimen. In figure 3 the finer net-work is wholly obliterated and only the coarse primary meshes have left their impression on the sandstone cast. On the other side (figure 4) the primary bands are but obscurely visible while the minute ultimate meshes of the reticulum have left their impression on the thin shaly coating of the sandstone cast.

Chemung group. *Weston Mills, Cattaraugus county, New York.*

THYSANODICTYA TURRICULA, sp. nov.

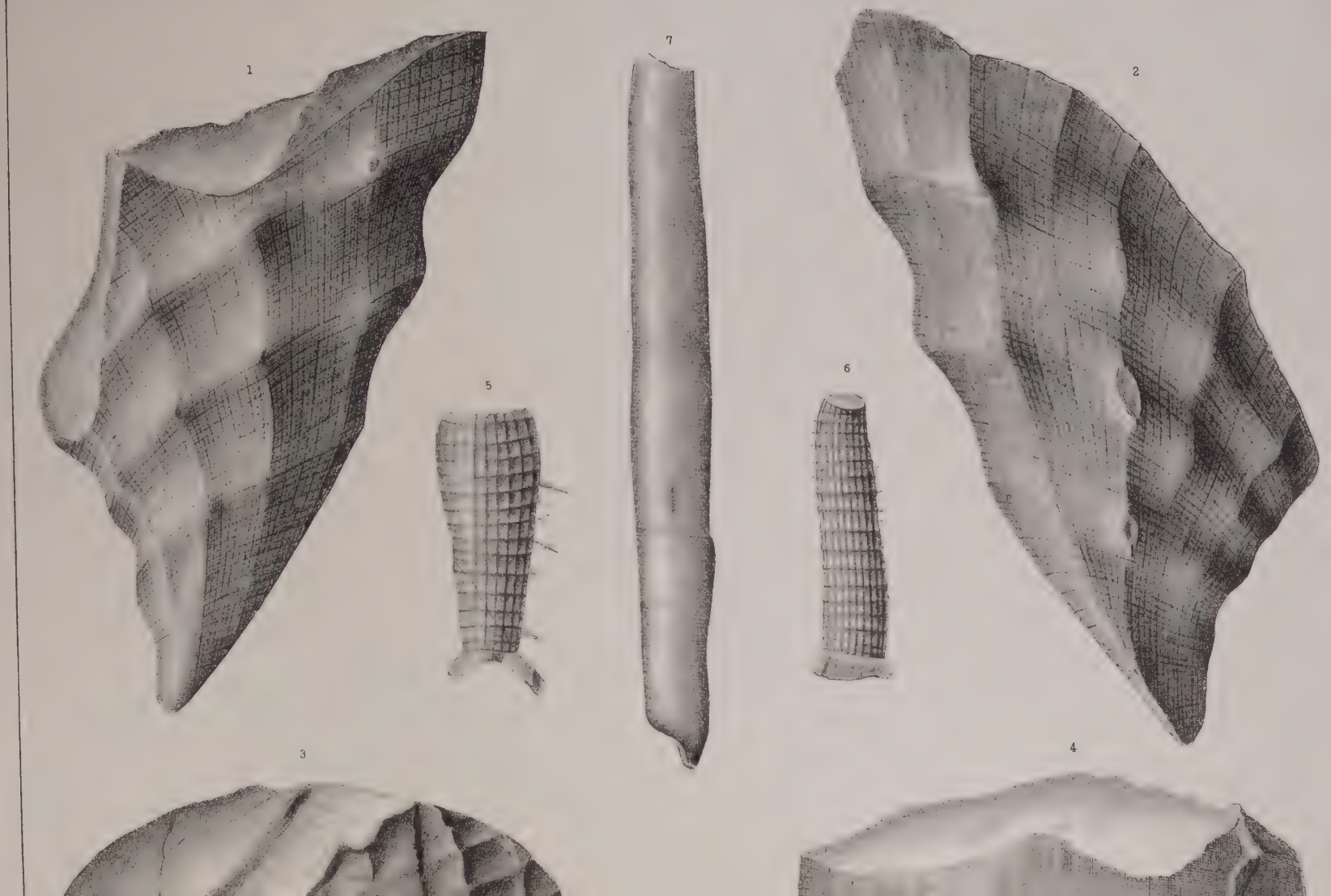
Page 875.

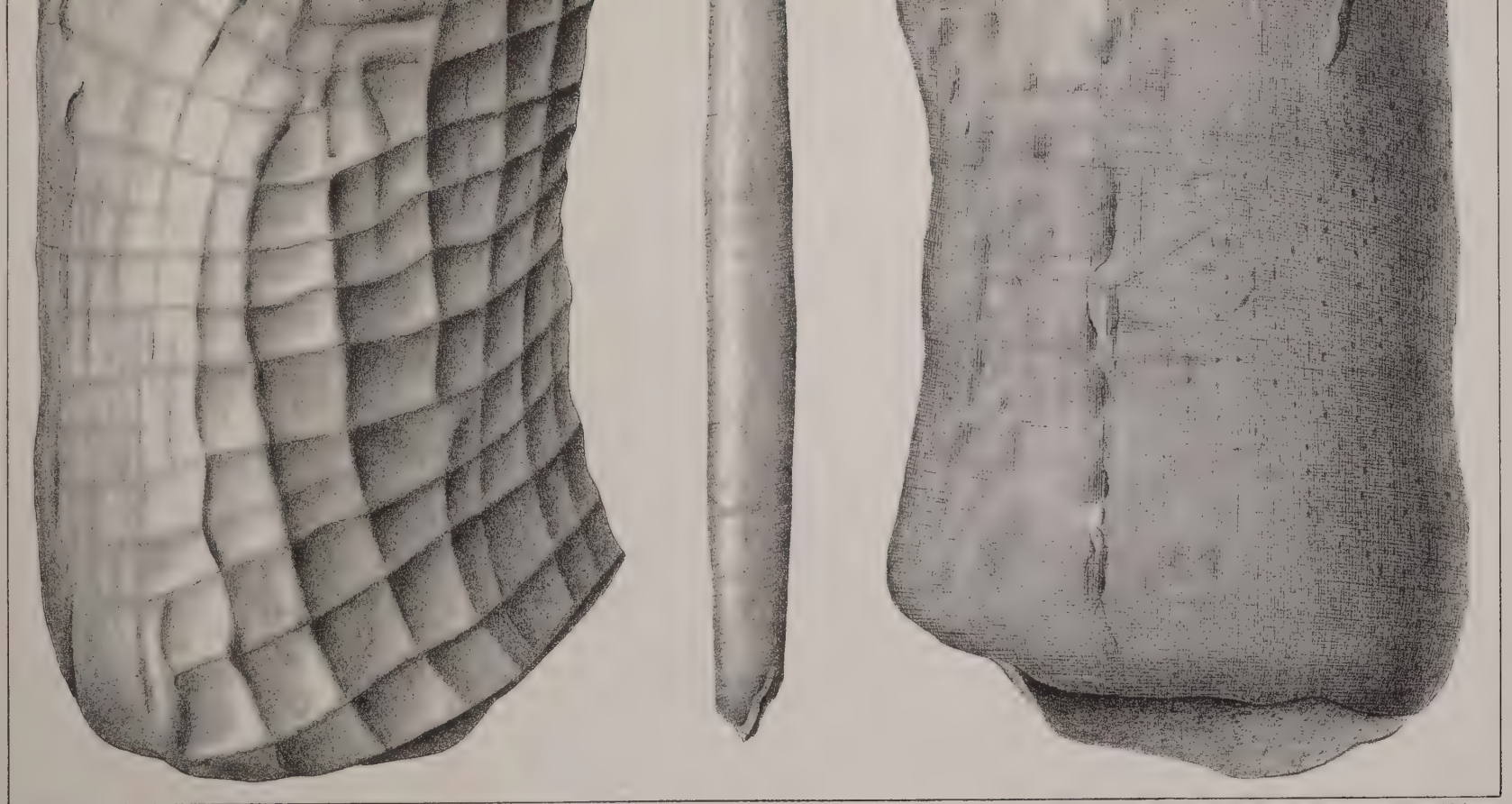
Figure 5. A coarsely reticulate specimen lying in its matrix and showing the basal diaphragm with some of the long and slender lateral tufts. The species is somewhat variable in shape and, in this instance, is swollen about the aperture.

Figure 6. A specimen which is essentially entire and gently tapers from base to aperture. It retains the basal disc and portions of the lateral tufts.

Chemung group. *Ischua, New York.*

DICTYOSPONGIDÆ.





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DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA (?) BACTERIA, sp. nov.

Page 817.

Figures 7, 8. Two views of a supposed sponge with smooth surface, bearing very faint horizontal lines which are exaggerated in the drawings in order to make them visible. The fossil does not clearly show a structure which conclusively demonstrates it spongeous nature. Chemung group. *Steuben county* (*?*), *New York.*

PLATE XXXIX.

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XLVI.)

HYDNOCERAS MULTINODOSUM, sp. nov.

Page 846.

Figure 1. Fragment of a large individual bearing three horizontal rows of nodes and showing the unusual number of nodes in each row.
Chemung group. *Cotton hill, near Avoca, New York.*

THYSANODICTYA, gen. nov.

Page 865.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXVII, XXXVIII, XL, XLII, LIII.)

THYSANODICTYA HERMENIA, sp. nov.

Page 873.

(See Plates XXVII and XL.)

Figure 2. A large basal disc with its undulated periloph or peripheral expansion. The reticular net-work is sharply defined and it is seen that the two sets of reticular bands here intersecting are those which, passing upward over the vertical surface of the frond, produce both horizontal and vertical bands.
Chemung group. *Hinsdale, Cattaraugus county, New York.*

DICTYOSPONGIDÆ.

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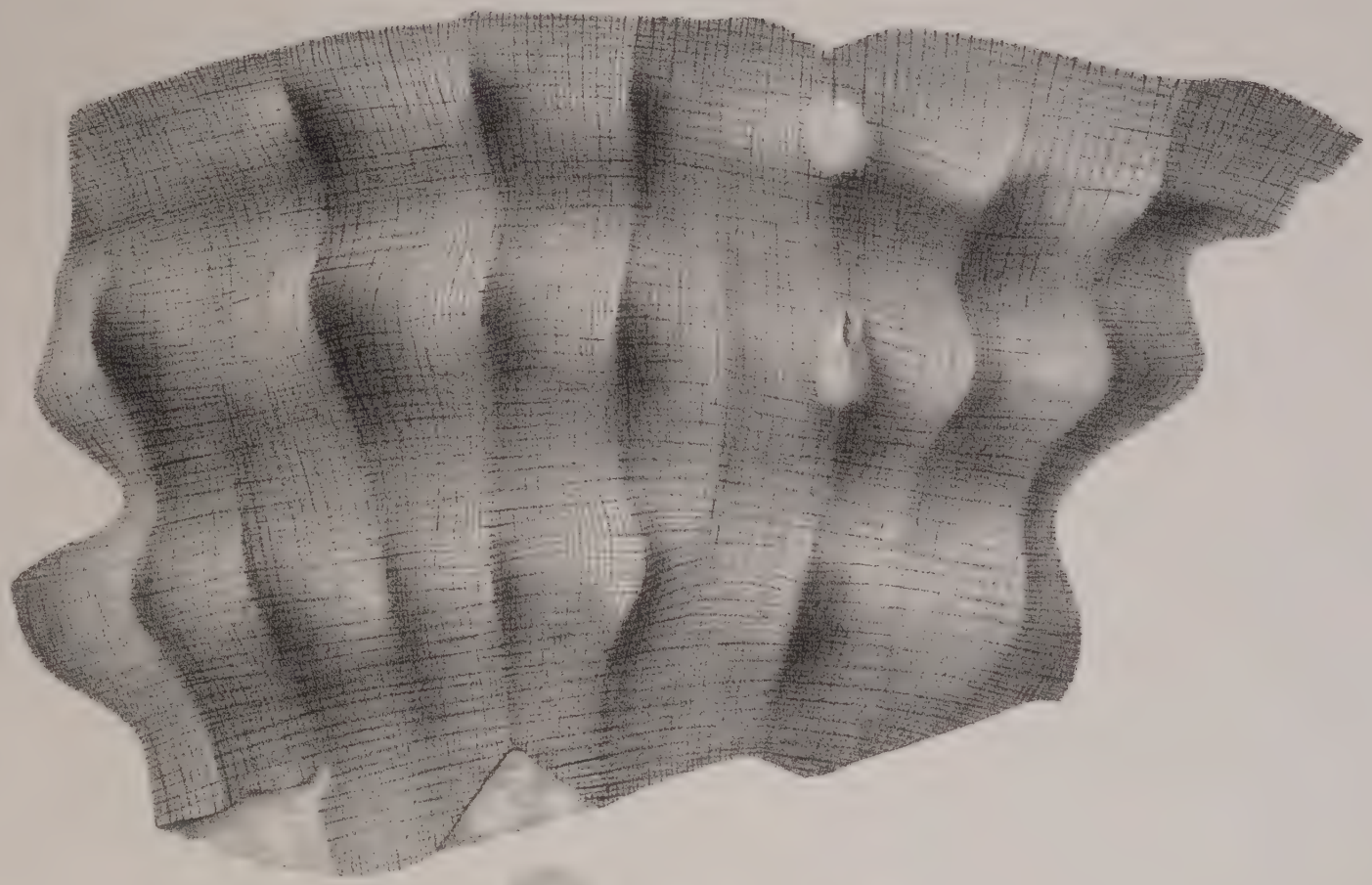

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PLATE XL.

THYSANODICTYA, gen. nov.

Page 865.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXVII, XXXVIII, XXXIX, XLII, LIII.)

THYSANODICTYA HERMENIA, sp. nov.

Page 873.

(See Plates XXVII and XXXIX.)

Figures 1, 2. Basal discs without the periloph but preserving more or less completely the coarser and finer reticulation.

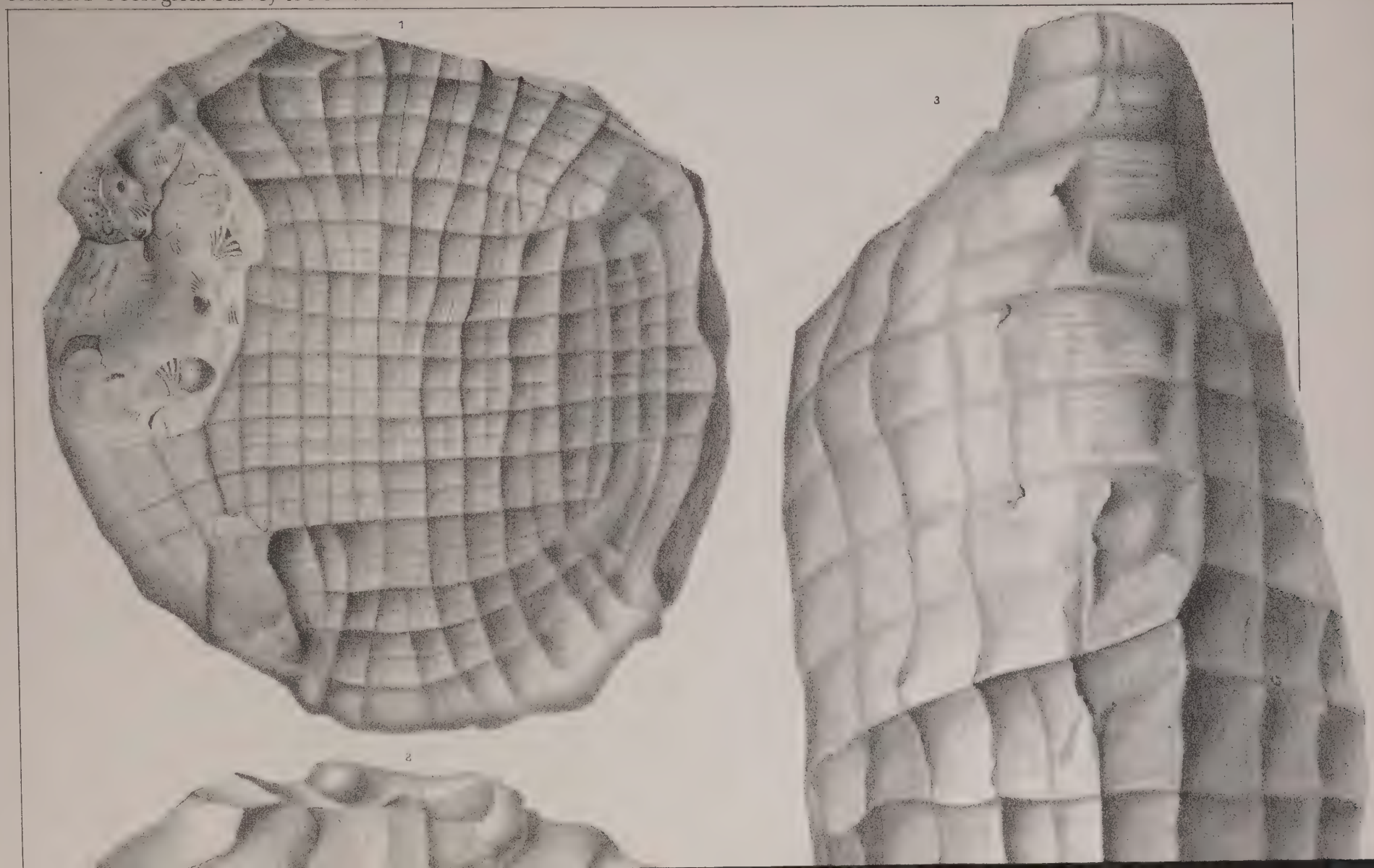
Figure 3. Side view of a rather small specimen with the basal disc poorly retained. The sponge has been crushed toward the upper end and a part of its diameter with, doubtless, a considerable portion of the length has been lost.

Chemung group. *Hinsdale, Cattaraugus county, New York.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York.

Plate XL.



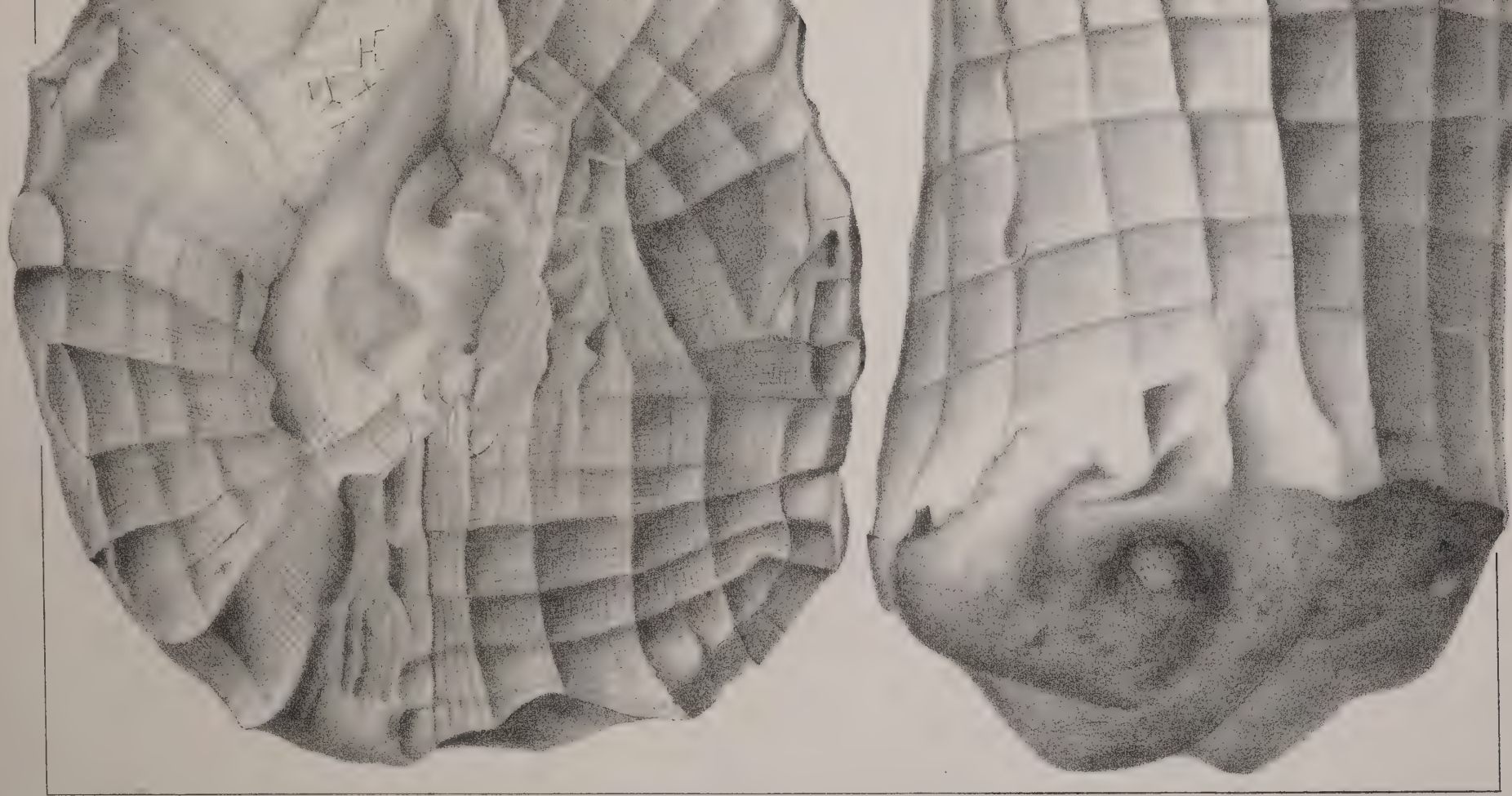


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PLATE XLI.

CERATODICTYA, gen. nov.

Page 857.

(See Plates XXII, XLII, XLIII.)

CERATODICTYA CENTETA, sp. nov.

Page 860.

Figure 1. A very young individual.

Figure 2. A fragment of a large example.

Figures 3, 4, 5. Specimens of medium size, showing some irregularity in the size of, and intervals between the annulations.

Chemung group. *Ischua, New York.*

CERATODICTYA ZONATA, sp. nov.

Page 859.

Figure 6. The type-specimen, showing equidistant and broad annulations.

Chemung group. *Found loose at Erie, Pennsylvania.*

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLII, LV.)

PRISMODICTYA AULOPHIA, sp. nov.

Page 828.

(See Plates XX and XXXIV.)

Figure 7. Fragment of a large specimen; showing the concave prism-faces and finely preserved net-work.

Chemung group. *Wellsville, New York.*

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA (?) MARCELLIA, Clarke (sp.).

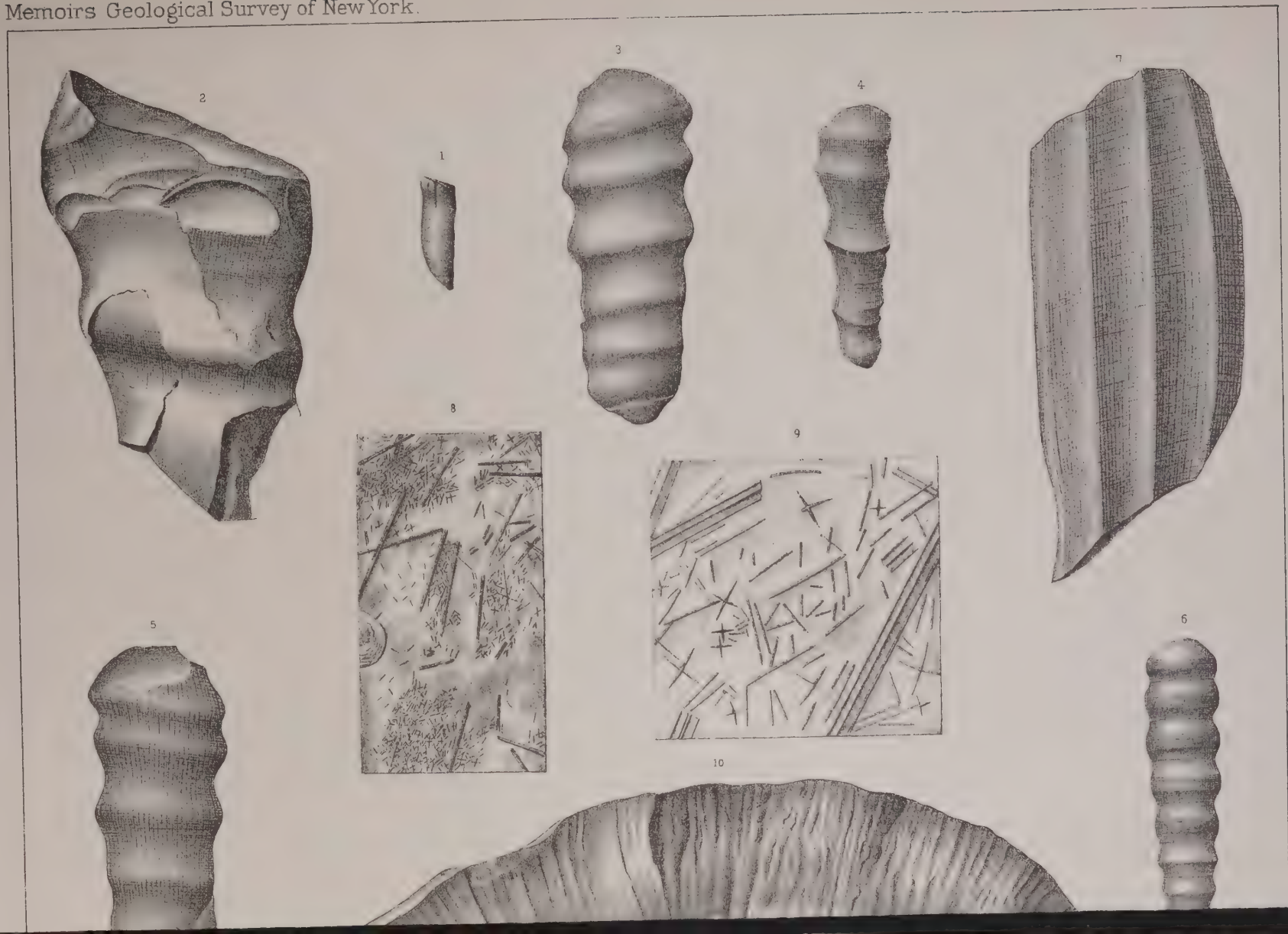
Page 805.

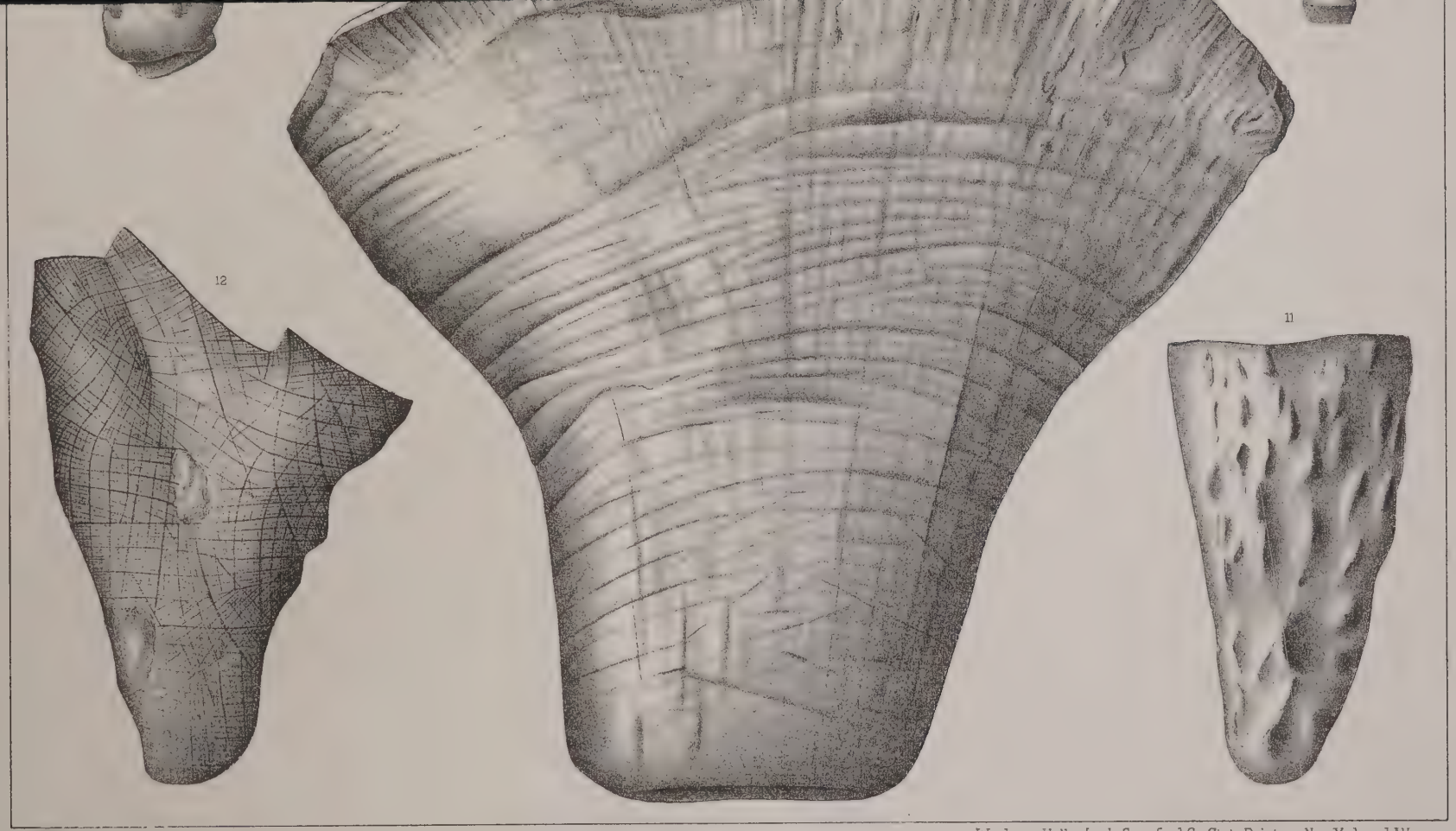
Figure 8. A portion of the suface of a piece of bituminous shale covered with pyritized spicules of this species.

Figure 9. An enlargement from the same, showing the cruciform spicules and the broad ligulate spicules whose position in the skeleton is not yet understood.

Marcellus shale. *In the Livonia salt shaft, Livonia, New York.*

DICTYOSPONGIDÆ.





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ARYSTIDICTYA, gen. nov.

Page 876.

(See Plate XLII.)

ARYSTIDICTYA ELEGANS, sp. nov.

Page 876.

(See Plate XLII.)

Figure 10. One side of the typical specimen which is preserved from the base or basal disc to the aperture. The drawing has intensified the wrinkles of the reticulum resulting from a slight foreshortening, and fails to give with proper force the regularly reticulating bands which are clearly apparent especially over the lower part of the sponge. The marginal radiating channels about the edge of the vase are well shown.

Lower Chemung group. *Cotton hill, near Avoca, New York.*

ARYSTIDICTYA NODIFERA, sp. nov.

Page 877.

Figure 11. The specimen described; a portion of a vase-shaped sponge like *A. elegans*, having the surface covered with elongate, irregularly disposed nodes.

Lower Chemung group. *Cotton hill, near Avoca, New York.*

HALLODICTYA, gen. nov.

Page 880.

(See Plate XXXVI.)

HALLODICTYA COTTONIANA, sp. nov.

Page 882.

Figure 12. A fragment of a frond having a sharply, somewhat irregularly reticulate surface, free of nodes.

Lower Chemung group. *Cotton hill, near Avoca, New York.*

PLATE XLII.

CERATODICTYA, gen. nov.

Page 857.

(See Plates XXII, XLI, XLIII.)

CERATODICTYA CARPENTERIANA, sp. nov.

Page 857.

(See Plate XLIII.)

Figure 1. A finely preserved specimen of a part of the sponge, having an apparently normal curvature, and showing the character of the reticulum and the duplicate annulations.
Chemung group. *Near Ischua, New York.*

PRISMODICTYA, gen. nov.

Page 819.

(See Plates XVII, XVIII, XIX, XX, XXI, XXVII, XXXIII, XXXIV, XXXV, XXXVI, XLI, LV.)

PRISMODICTYA TELUM, Hall (sp.).

Page 820.

(See Plates XVII and XXXV.)

Figure 2. A small cigar-shaped individual showing a twisted or spiral mode of growth.
Chemung group. *Wellsville, New York.*

PRISMODICTYA CERCIDEA, sp. nov.

Page 829.

(See Plate XX.)

Figure 3. A flattened but entire example, showing the expansion of the sponge above the middle and the low nodes on the prism-angles.
Chemung group. *Wellsville, New York.*

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLIV, XLVI, LV, LVI, LXI.)

DICTYOSPONGIA SIRÆA, sp. nov.

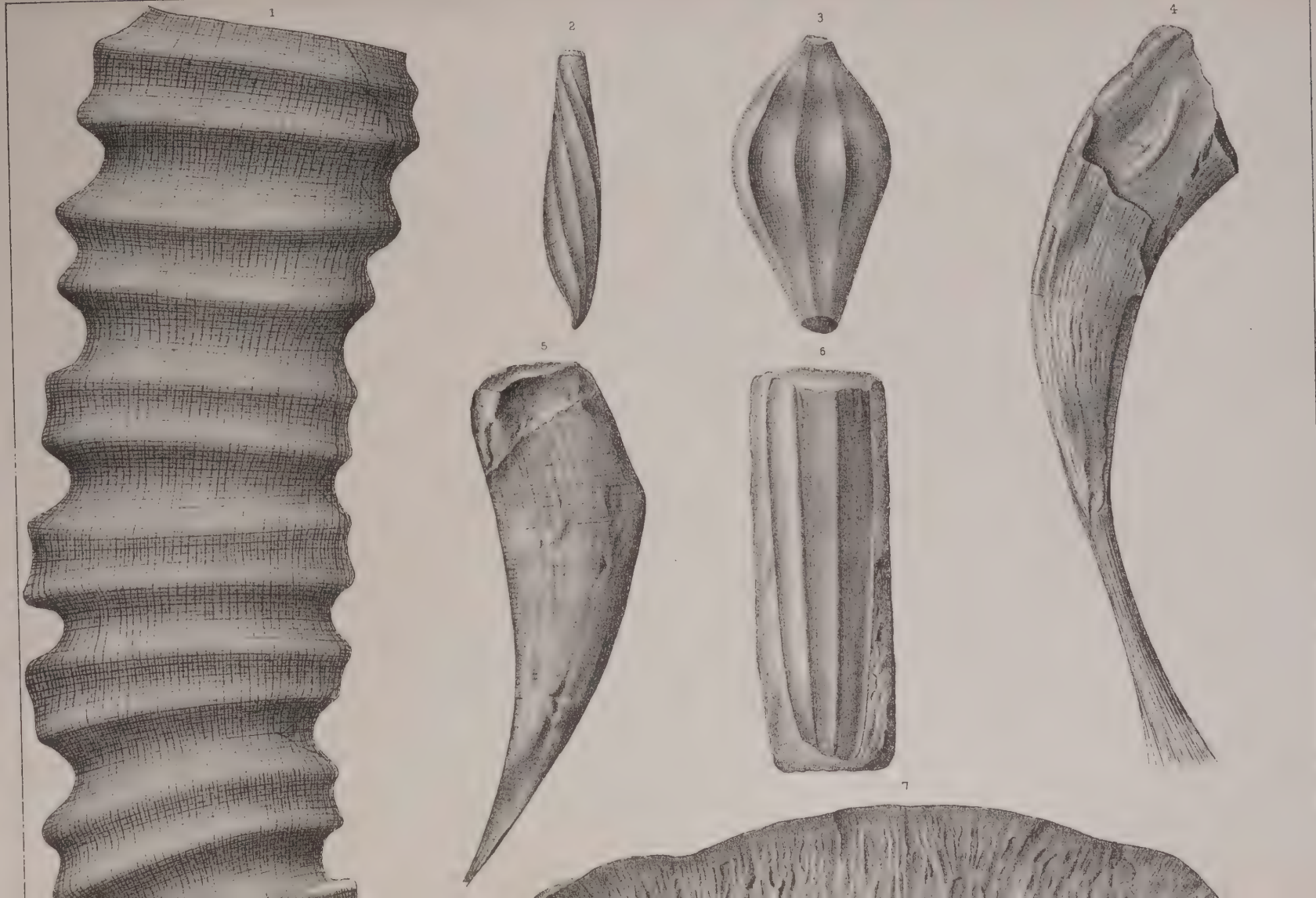
Page 815.

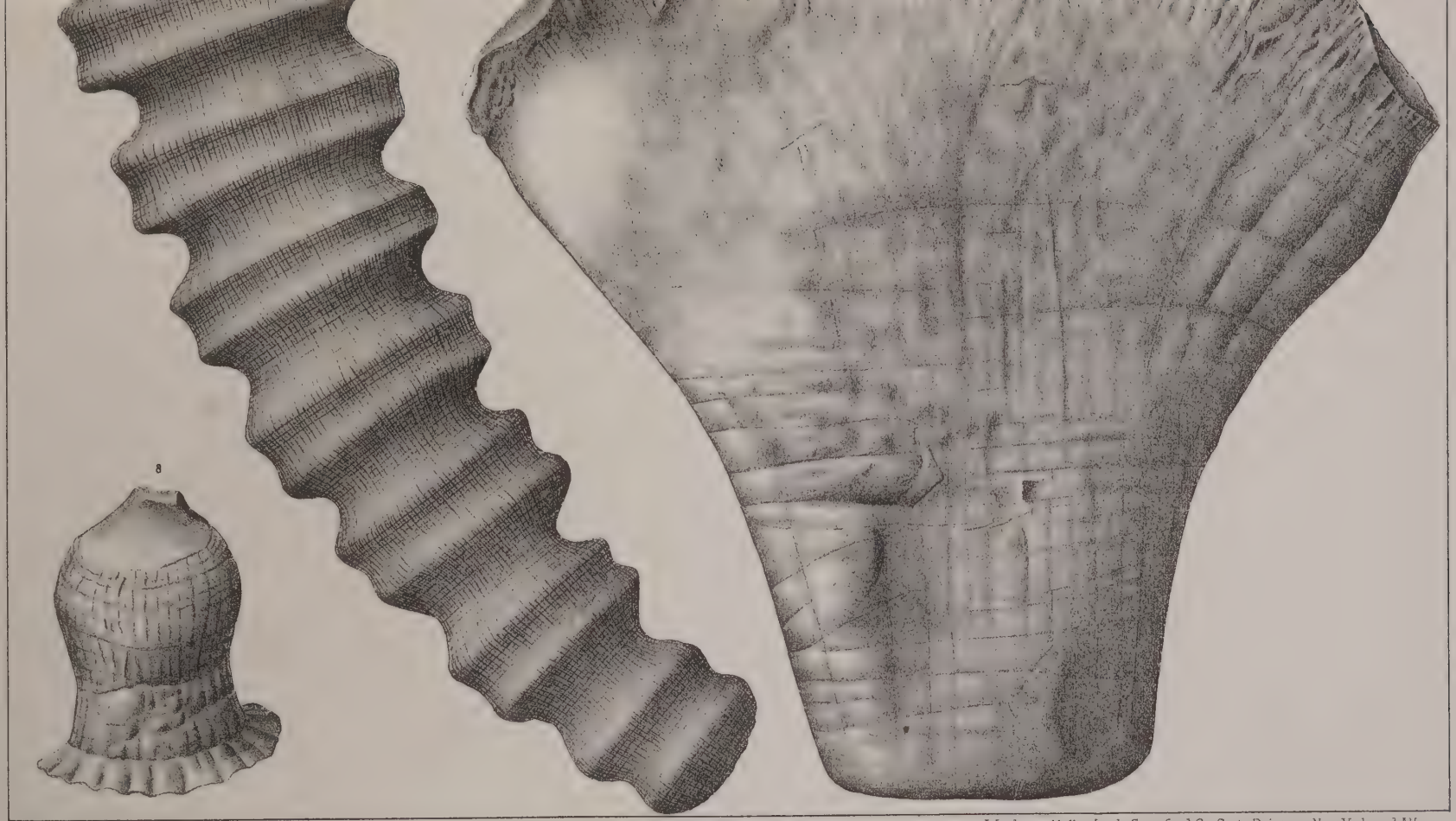
Figures 4, 5. Two individuals showing the size and general form of the species, one of them (figure 4) retaining the long tuft of basal spicules.
Lower Chemung group. *Cotton hill, near Avoca, New York.*

PRISMODICTYA cf. PRISMATICA, Hall.

Figure 6. Part of a cup which may prove to belong to this species.
Lower Chemung group. *Italy, Yates county, New York.*

DICTYOSPONGIDÆ.





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ARYSTIDICTYA, gen. nov.

Page 876.

(See Plate XLI.)

ARYSTIDICTYA ELEGANS, sp. nov.

Page 876.

(See Plate XLI.)

Figure 7. The other side of the specimen figured on Plate xli, showing the regular reticulation over the lower part of the cast and the radiating peripheral channels.

Lower Chemung group. *Cotton hill, near Avoca, New York.*

THYSANODICTYA, gen. nov.

Page 865.

(See Plates XIX, XXIII, XXIV, XXV, XXVI, XXVII, XXXVIII, XXXIX, XL, XLII, LIII.)

THYSANODICTYA SCYPHINA, sp. nov.

Page 872.

Figure 8. The typical specimen, showing the undulated basal periloph or fringe of the diaphragm.

Chemung group. *Olean, New York.*

PLATE XLIII.

CERATODICTYA, gen. nov.

Page 857.

(See Plates XXII, XLI, XLII.)

CERATODICTYA CARPENTERIANA, sp. nov.

Page 857.

(See Plate XLII.)

Figure 1. A large fragment of this species, complete at neither extremity. This drawing has been made from several pieces of the same individual and as these did not perfectly fit, the figure does not represent the entire length of the fragment. The specimen shows the very gradual expansion of the sponge, indicating that it must have attained great length at full growth.

Figure 2. Another fragment preserving the apical portion entire and showing the gradual change with growth in the aspect of the annulations. Chemung group. *Near Ischua, New York.*

Figure 3. A very imperfect fragment from near the aperture of a full grown specimen. This specimen indicates the great length which the species must have attained and shows the ultimate modification in the form of the annulations which are here brought so close together that their duplicate character is obscured.
Chemung group. *Randolph, New York.*

DICTYOSPONGIDÆ.

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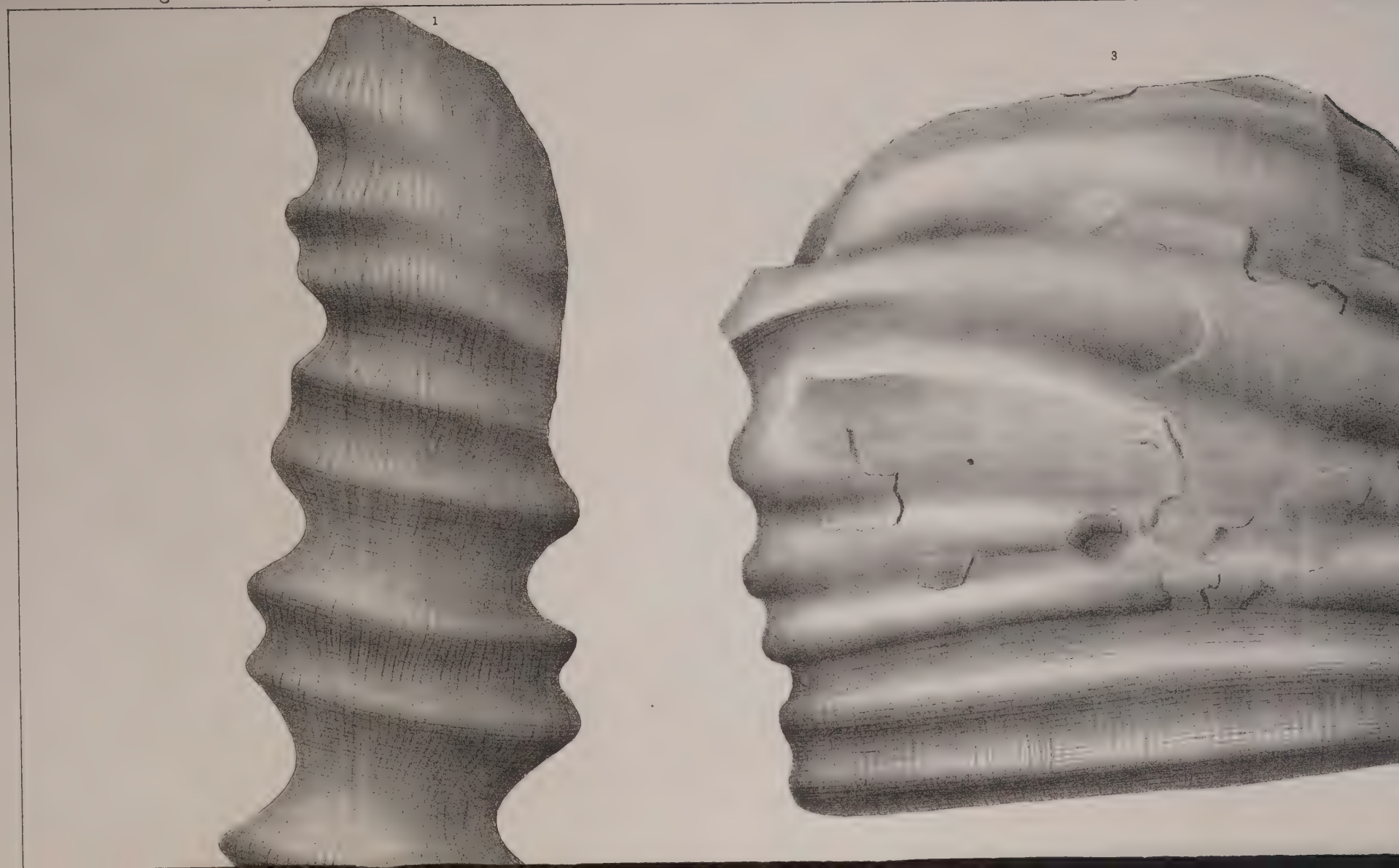

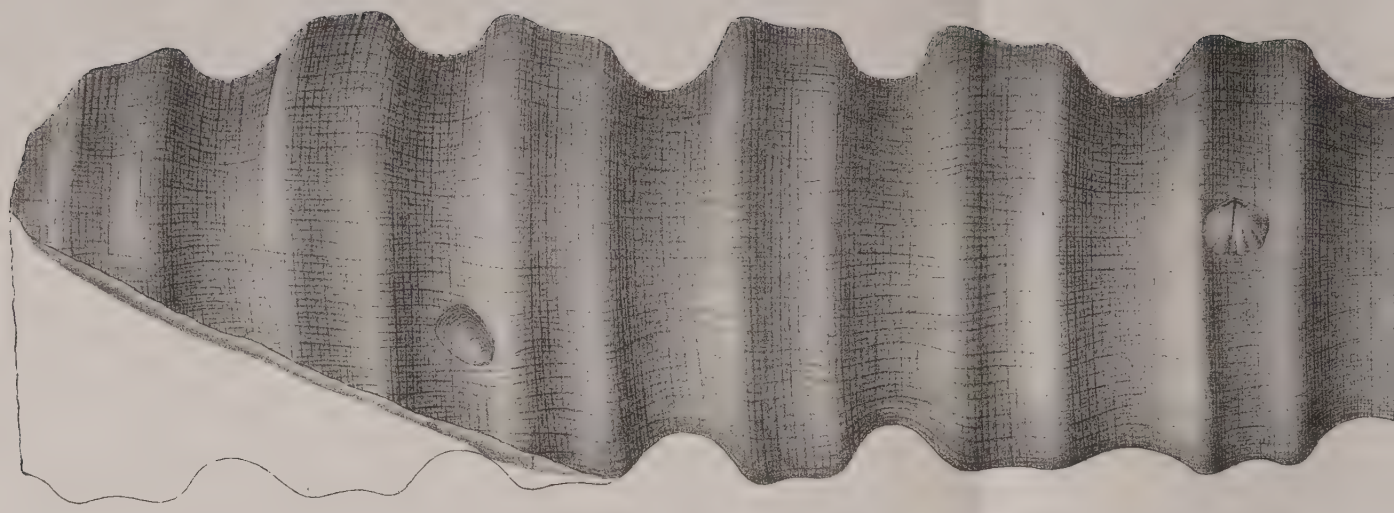

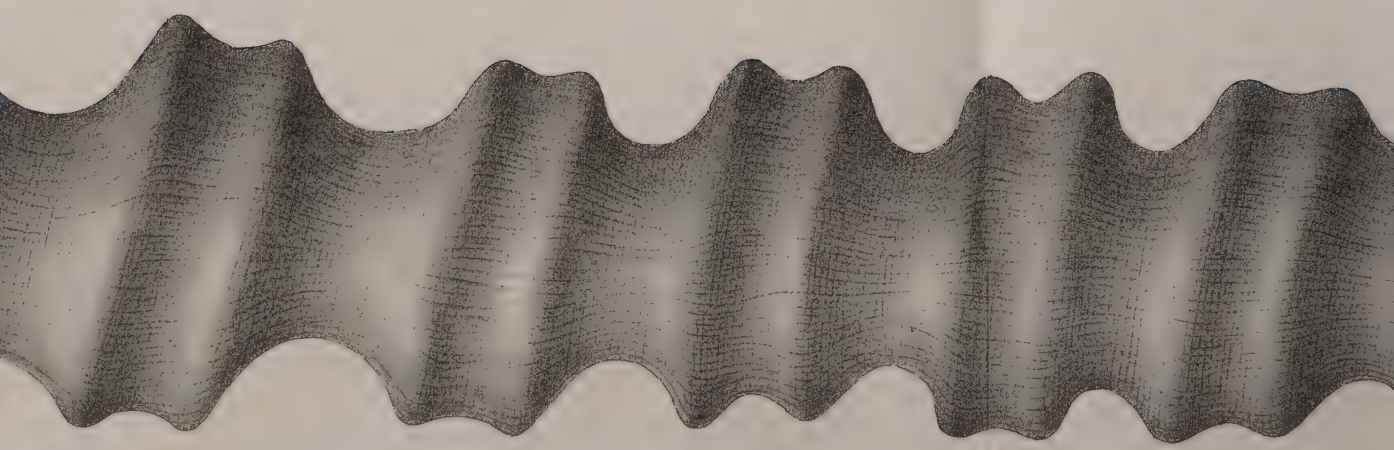

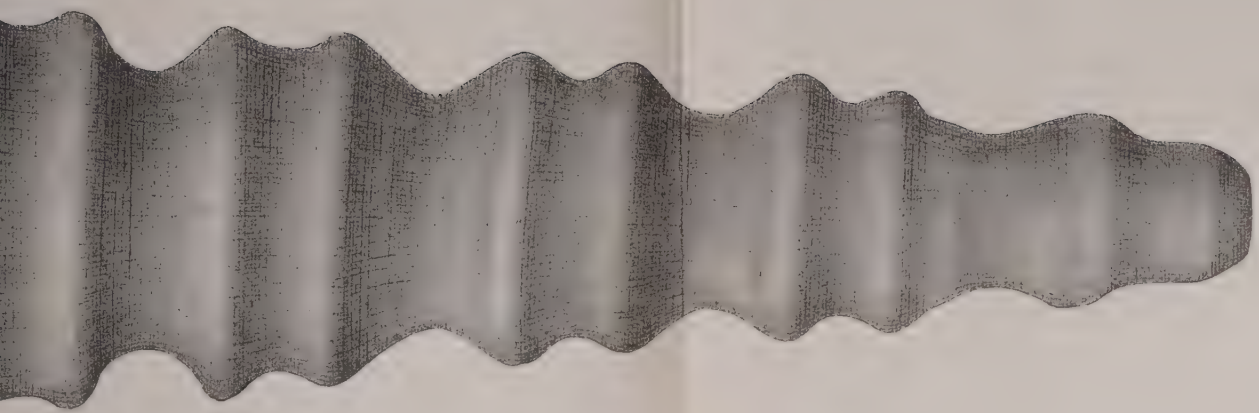

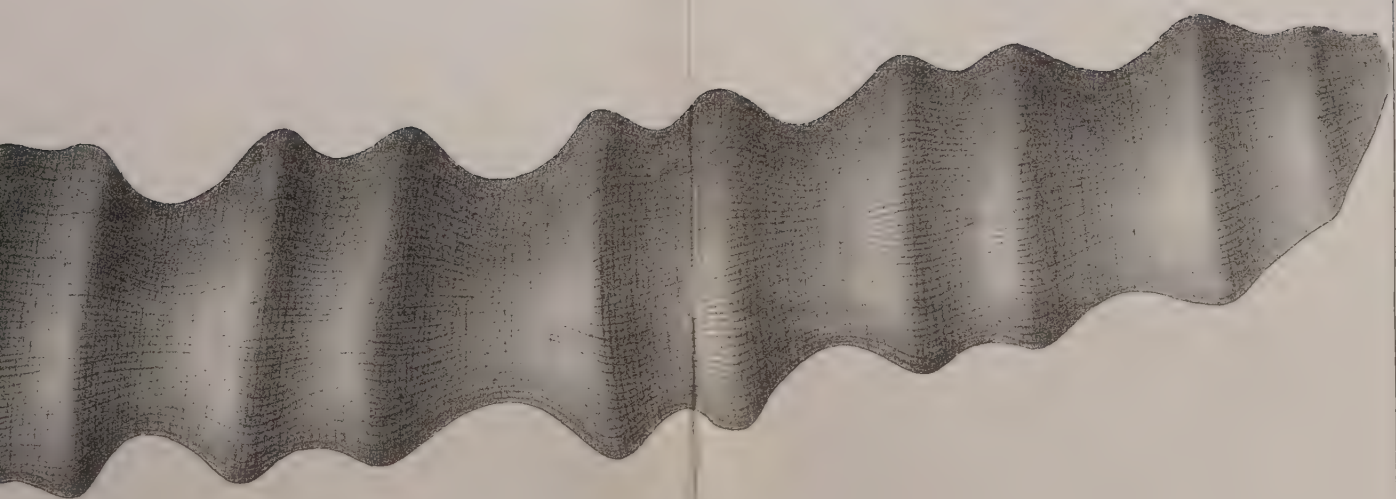

PLATE XLIV.

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLVI, LV, LVI. LXI.)

DICTYOSPONGIA ALMONDENSIS, sp. nov.

Page 816.

Figure 1. A large fragment representing the upper part of a frond of great size. Fragments of this character abound at the locality from which this was obtained, but so large and fragile was the sponge that no entire individual has been obtained and but very few specimens which afford a clew to the original form of the species. Elsewhere is given a drawing of the apical portion of one of these sponges which shows that it was doubtless a DICTYOSPONGIA.

Chemung group. *In a bed of grey sandstone, at Almond, New York.*

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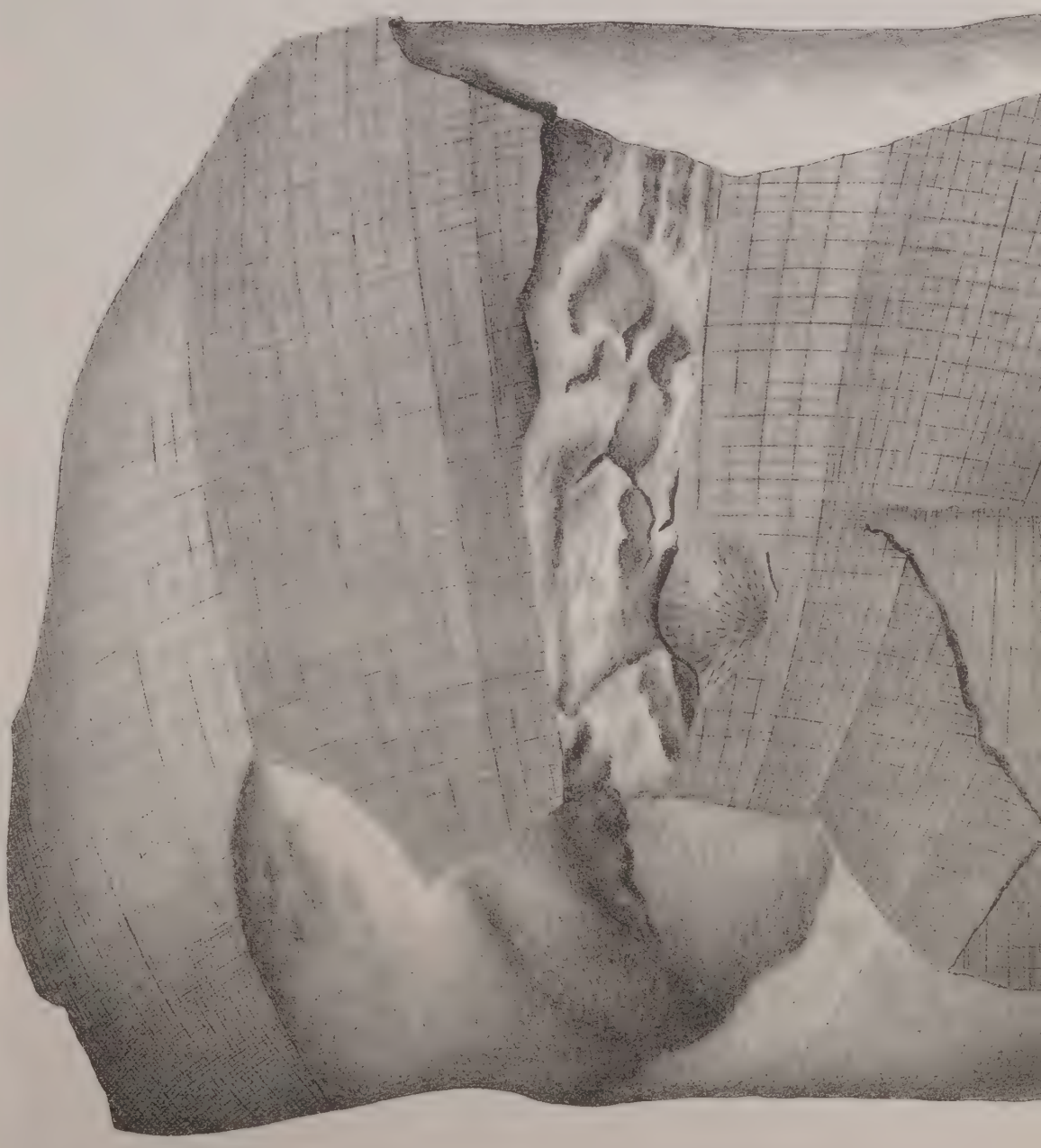

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PLATE XLV.

HYPHANTÆNIA, Vanuxem (*emend.*).

Page 877.

(See Plates XXVIII and XXIX.)

HYPHANTÆNIA CHEMUNGENSIS, Vanuxem.

Page 879.

(See Plates XXVIII and XXIX.)

Figure 1. Fragment of the largest individual observed, slightly fractured near the middle. This specimen differs from those elsewhere figured in having the apertures left by the intersection of the ligulate bands circumscribed by an encroachment of the spicular tissue. The diameter of this specimen when entire was not less than two feet. Chemung group. *Union township, Broome county, New York.*

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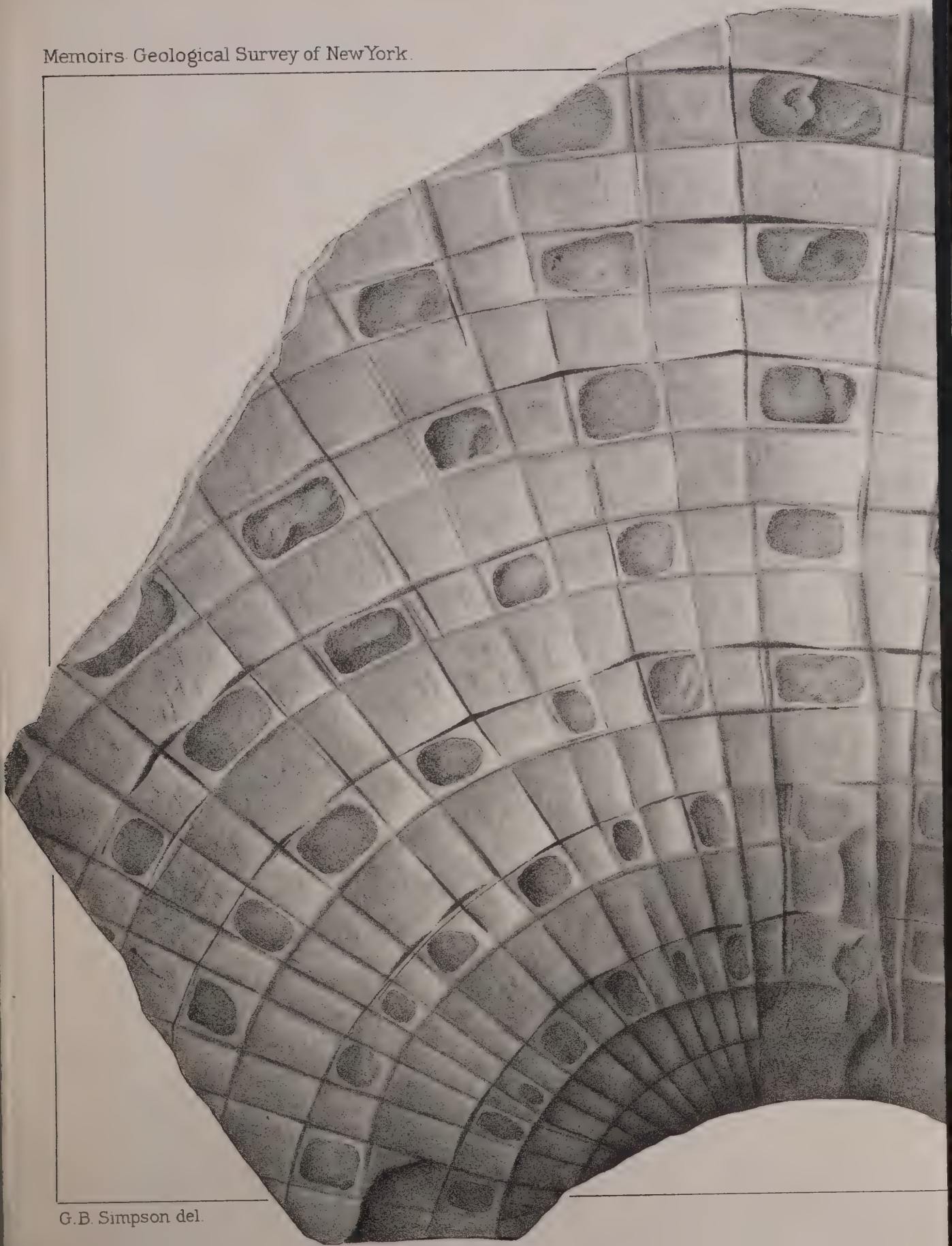

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Plate XLV.

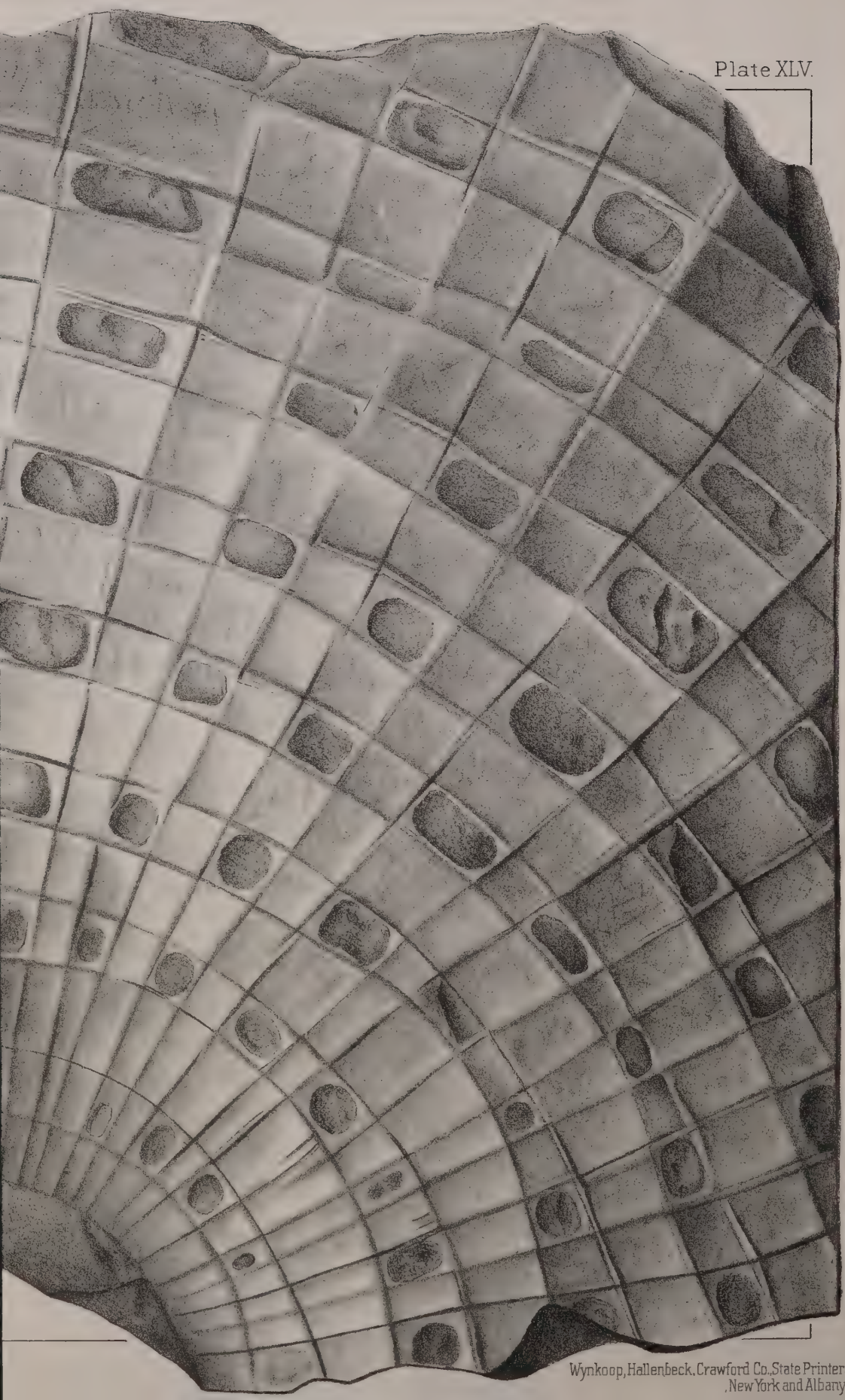

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PLATE XLVI.

Species from the Psammites du Condroz, submitted by Professor CHARLES BARROIS, *of Lille, France.*

DICTYOSPONGIA, gen. nov.

Page 812.

(See Plates XIV, XV, XVI, XXVII, XXXIII, XXXVI, XXXVIII, XLI, XLII, XLIV, LV, LVI, LXI.)

DICTYOSPONGIA MORINI, Barrois (sp.).

Page 887.

Figures 1, 2. Views of the original specimen showing the smooth, regularly expanding cup.

Psammites du Condroz. *Jeumont, France.*

HYDNOCERAS, Conrad.

Page 835.

(See Plates II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX.)

HYDNOCERAS BARROISI, nom. nov.

Page 887.

Figures 3, 4. The original specimen of *Dictyophyton tuberosum*, Barrois. This is a curved, strongly constricted cup, with moderately strong nodes upon the sharply developed prism-angles.

Psammites du Condroz. *Jeumont, France.*

HYDNOCERAS JEUMONTENSE, sp. nov.

Page 888.

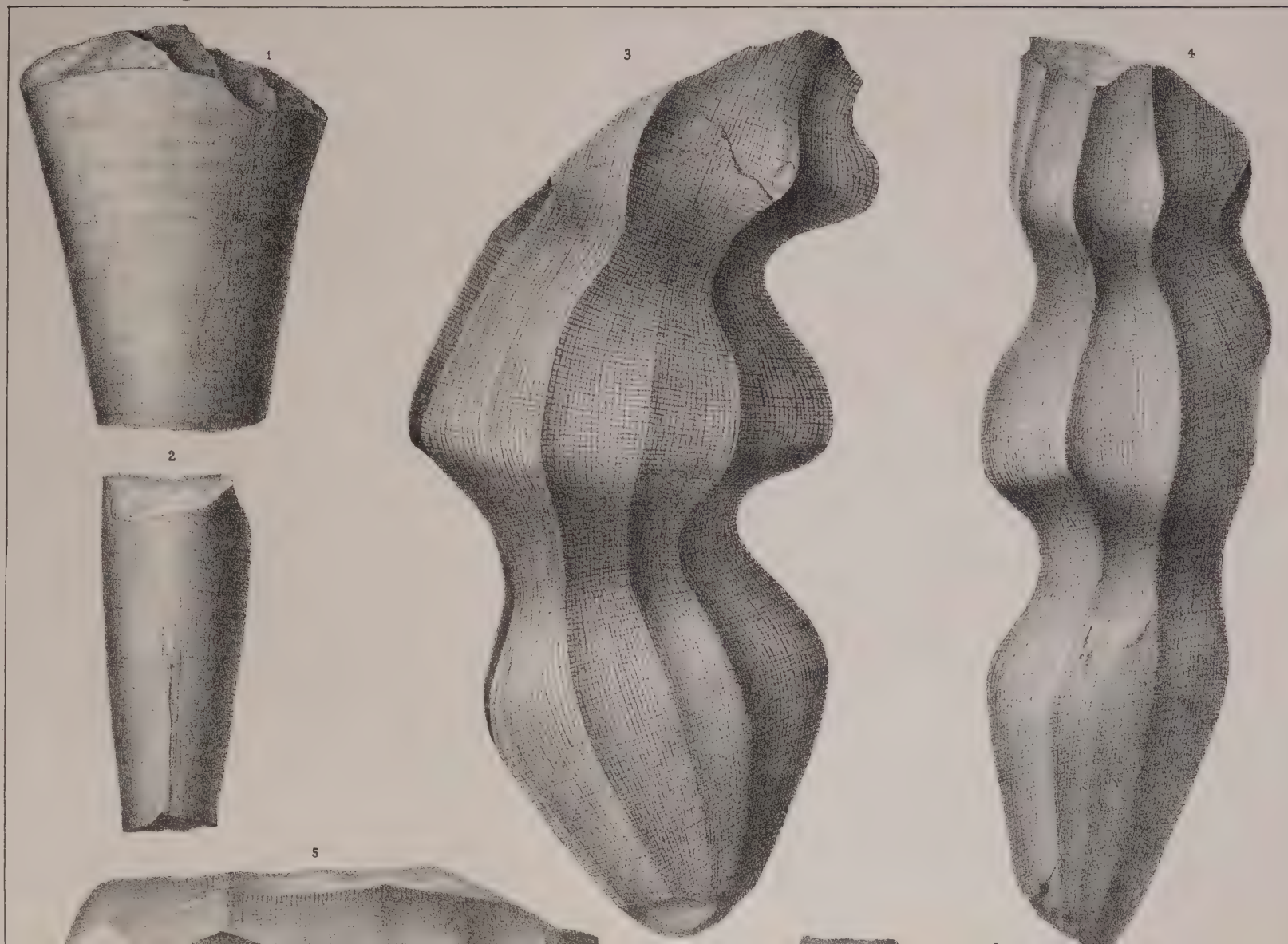
Figure 5. A specimen with three horizontal rows of nodes and showing very gradual expansion of the cup.

Figure 6. Another fragment of the same species showing some variation in the number of nodes in each horizontal row. An additional piece of this specimen increases its length by about 60 mm. and has traces of two rows of nodes.

Psammites du Condroz. *Jeumont, France.*

DICTYOSPONGIDÆ.

Memoirs Geological Survey of New York. Plate XLVI



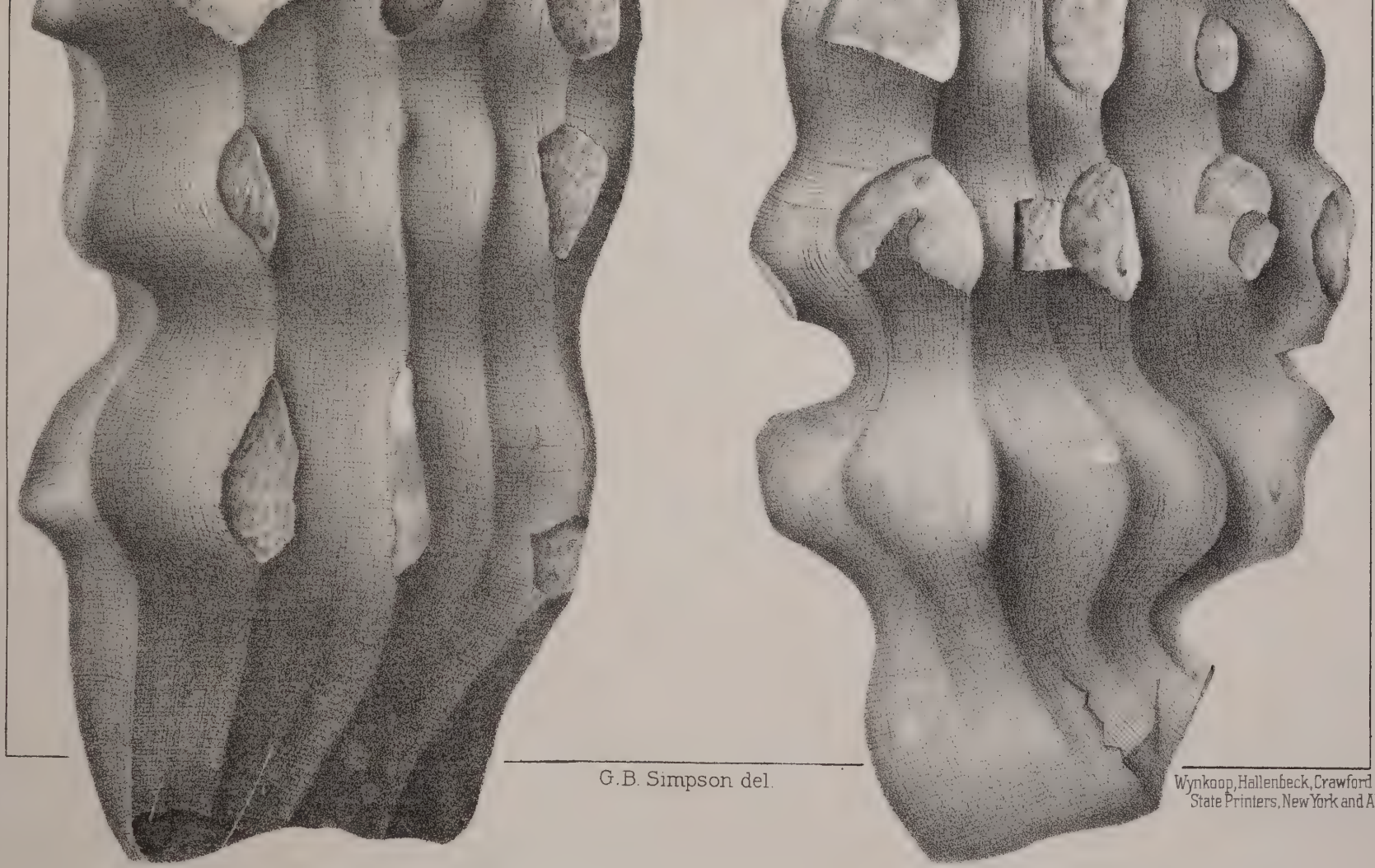


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PLATE XLVII.

Species from the Psammites du Condroz, submitted by Professor CHARLES BARROIS, *of Lille, France.*

RHABDOSISPONGIA, gen. nov.

Page 856.

(See Plate XVI.)

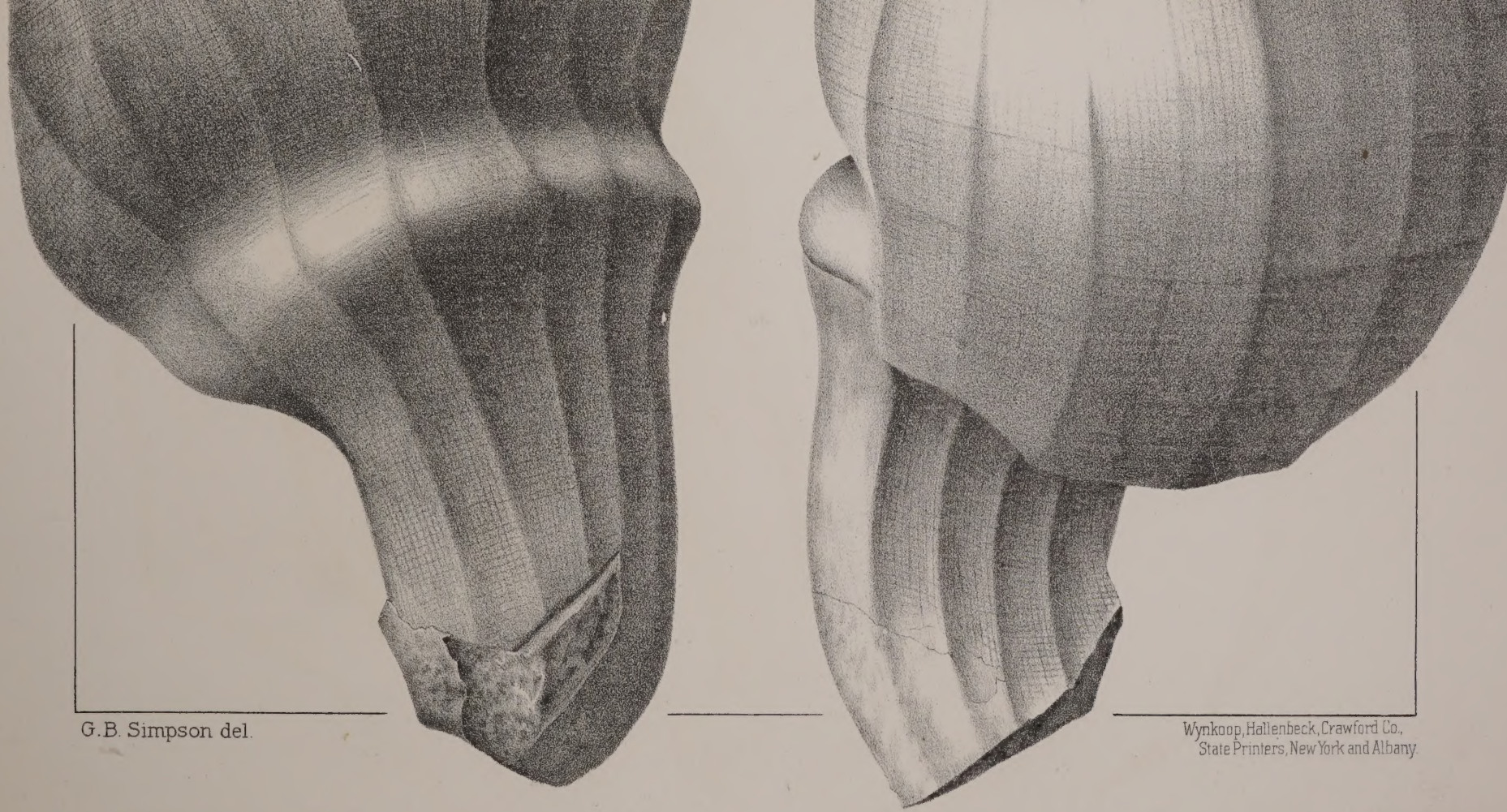
RHABDOSISPONGIA CONDROZIANA, sp. nov.

Page 889.

Figures 1, 2. Opposite sides of the original specimen showing its strong, unequal annulations, producing a highly irregular form, and also the sharply developed prism-faces.

Psammites du Condroz. *Jeumont, France.*

DICTYOSPONGIDÆ.



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